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SCHNEIDER (F.). **Zur Überwinterung von *Lasiopticus pyrastri* L. und *Lasiopticus seleniticus* Meig. (Dipt., Syrphidae).** [The Overwintering of *Lasiophthicus pyrastri* and *L. seleniticus*.]—*Mitt. schweiz. ent. Ges.* **20** pt. 4 pp. 306–316, 5 figs., 9 refs. Berne, 1947.

Although predacious Syrphids usually overwinter in the larval stage [*cf. R.A.E.*, A **17** 409], occasional observations in Switzerland in 1942–46 indicated that *Lasiophthicus pyrastri*, L., and *L. seleniticus*, Mg., also do so as adult females. These two species, the adults of which are briefly described, are very similar in appearance and are often confused in the literature, but whereas larvae of *L. pyrastri* have been recorded as attacking Aphids on a number of cultivated plants, captures of adults of *L. seleniticus* indicate that the larvae of this species do so chiefly on forest trees.

A female of *L. pyrastri* was taken in flight in January 1944 in relatively mild weather, and nine were taken on flowering *Eranthis hiemalis* in March 1943; the physiological condition of all these indicated that they could not be newly emerged and all had paired. Sexually immature females of *L. seleniticus* were taken in flight in October in 1943 and 1945 and November in 1943 and 1946 close to the roofs and windows of dwellings, where they were probably going to overwinter; some of them had been feeding on nectar and honey-dew and contained considerable fat reserves. Ten females caught on 2nd November 1943 and kept without food, two at 0°C. [32°F.] and two at 6°C. [42·8°F.] in the laboratory and six in the open in a dry, shady position, were all alive on 9th March 1944, except one kept at 0°C. When hibernating females were transferred in November to temperatures of about 20°C. [68°F.] or higher, the rate of metabolism was greatly increased, and after about a week, the females fed, on pollen, matured their eggs and oviposited.

It is concluded that adults of *Lasiophthicus* pair in autumn, whereupon the males die. The females ingest food with a high sugar-content and seek winter quarters during October–November, *L. seleniticus* hibernating in the cracks in the roofs of houses or possibly in fissures in forest trees. They emerge from hibernation in early spring and feed on pollen (maturation feeding), subsequently ovipositing among early colonies of Aphids. Since five females of *Syrphus* (*Epistrophe*) *balteatus*, Deg., were also found on flowering *Eranthis* early in March 1943, it is possible that they too had overwintered.

GRUBER (M.), GÜNTHART (E.) & HOLENSTEIN (R.). **Die ovizide Wirkung von Winterspritzmitteln für den Obstbau. Laboratoriumsmässige Prüfung mit Eiern der Mehlmotte, *Ephestia kühniella* Zell.** [The ovicidal Effect of Winter Sprays for Fruit Trees. Laboratory Tests with Eggs of *E. kuehniella*.]—*Mitt. schweiz. ent. Ges.* **20** pt. 4 pp. 317–322. Berne, 1947.

An account is given of laboratory tests in Switzerland to compare the ovicidal effect of proprietary winter sprays for use on fruit trees. The preparations tested comprised a paste and several powders containing 22–23 per cent. DNC (dinitro-o-cresol), a powder containing 11–12 per cent. DNC and copper oxychloride, and petroleum oil emulsions and tar distillates (fruit-tree carbolineums), alone or with DNC. Eggs of *Ephestia kuehniella*, Zell., were employed, since they proved to be as resistant as those of *Operophtera brumata*, L., *Argyresthia ephippella*, F., and Aphids, and are obtainable throughout the year [*cf. R.A.E.*, A **33** 15]. They were placed in small glass dishes, the fluid to be tested was poured over them and agitated for ten seconds, and they were then transferred to filter paper and kept at room temperature for 3–4 weeks before being examined. The results, details of which are given in tables, showed that the powders that gave liquids with a strongly alkaline reaction, were unsatisfactory even at concentrations of more than 2 per cent., whereas

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those that gave an acid liquid and the paste, which gave an almost neutral one, caused almost complete mortality. Acid combinations of DNC with emulsified carbolineum [*cf.* **35** 70] or oil emulsion also gave very high mortality, as did carbolineum alone at higher concentrations, but oil emulsions alone did not.

When the effect of the pH of the liquid was investigated, by using solutions of the sodium salt of DNC with pH values of 4–11, it was found that mortality decreased as the solutions became more alkaline. In solutions of low pH the greater part of the DNC is present as undissociated DNC, but in those of high pH as the salt dissolved in water, so that these results confirmed Dierick's view that the undissociated DNC molecules are highly toxic, but not the dissociated DNC ions of the salt [*cf.* **33** 15].

To test the influence on mortality of air humidity after treatment, treated eggs were placed in petri dishes and kept at relative humidities of 100–35 per cent. and room temperature. It was found that the acid and neutral preparations were more toxic in a moist than in a dry atmosphere, but this difference was less marked in the case of alkaline preparations, although in some cases a higher mortality was obtained in a moist atmosphere ; a preparation containing DNC and emulsified carbolineum (Veralin 3) was least affected by differences in air humidity. Further tests showed that most of the DNC preparations were much more toxic to eggs that were about to hatch than to freshly laid ones, whereas the reverse was the case with the carbolineums ; Veralin 3 showed only a slight decline in effectiveness just before the eggs hatched, and gave excellent control throughout the embryonic period. It is emphasised that these preparations should be subjected to further tests before being applied against eggs of other species in the field.

MÜLLER (P.). **Relations entre la constitution chimique et l'action insecticide dans le groupe du dichlorodiphenyltrichloréthane et dérivés apparentés.**— *Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 97–109. Heverlee [? 1947].

Since the insecticidal action of DDT and related compounds may be due to a chemical change in the molecule, such as the liberation of hydrogen chloride, or to the arrangement of the groups of atoms in it, experiments were carried out with a large number of the compounds to compare their insecticidal action and their ability to liberate HCl [*cf. R.A.E.*, A **35** 203, etc.].

In the insecticidal tests, blowflies (*Calliphora vomitoria*, L.) were the chief test insects. The compounds were dissolved in acetone at concentrations of 10, 5 and 1 gm. per litre, and 1 cc. of solution was put into the base and the lid of each of a number of petri dishes ; one hour after the acetone had evaporated, five flies were put in each dish and the times taken to paralyse and kill them at a temperature of 22°C. [71·6°F.] observed. To measure the liberation of HCl, 0·01 gm. molecule of each compound was dissolved in 250 cc. alcohol, 25 cc. of a normal alcohol solution of potassium hydroxide was added, and the mixture was allowed to stand for 16 hours at room temperature and then titrated with phenolphthalein.

With the exception of the hydroxy analogue, all analogues of DDT (4,4′-dichlordiphenyltrichlorethane) obtained by substitution in the two para positions were toxic [*cf.* **34** 255] ; the fluorine analogue was more toxic than DDT and the methoxy analogue about as toxic as the latter. The toxicity of alkyl derivatives decreased as the chain of carbon atoms lengthened. Substitution of chlorine for hydrogen on the aliphatic radical of DDT gave a non-toxic compound. When two methyl radicals were substituted on each phenyl radical of diphenyltrichlorethane to form a symmetrical compound, the 3,4-analogue was active, but the 2,4- and 2,5- analogues completely inactive.

Asymmetrical substitution resulting in 4-chlordiphenyltrichlorethane, 4-chlor-4′-methyldiphenyltrichlorethane, 4-chlor-4′-n-propyldiphenyltrichlorethane and 4-chlor-3′,4′-dimethyldiphenyltrichlorethane gave compounds similar in toxicity to DDT, but 4-acetodiphenyltrichlorethane was inactive. Of the three isomers of DDT, 4,2′- and 2,2′-dichlordiphenyltrichlorethane were noticeably less active than the 4,4′- compound, whereas the 4,3′- compound had an action similar to it.

Of the symmetrical di-substituted derivatives of diphenyldichlorethane, which was itself inactive, those containing bromine or methoxyl in the para positions were less active than the corresponding chlorine, fluorine and methyl compounds, which were similar in toxicity to DDT. In contrast to that of DDT, the toxicity of the chlorine compound (DDD) was not affected by the substitution of chlorine for hydrogen on the aliphatic radical. Bis-(4-chlor-2-methylphenyl)-dichlorethane and the three symmetrical isomers of bis-(dimethylphenyl)-dichlorethane were all inactive.

The chemical tests showed that all derivatives with chlorine, bromine or fluorine in the two para positions liberated about 1 gm. molecule of HCl, whereas the 4,4′-dimethoxy or dimethyl derivatives liberated only 0·3 gm. molecule. All the tetra-substituted derivatives liberated little or no HCl, although they varied from inactivity to great toxicity against insects. The DDD series gave similarly contradictory results, diphenyldichlorethane, which liberated much HCl, being completely inactive as an insecticide, whereas 4,4′-dimethyldiphenyldichlorethane, which liberated practically none, was active, and it is concluded that it is impossible to estimate any relation between liberation of HCl and insecticidal activity.

KUSTERS (C.). **Sur la chloruration des noyaux benzénique et naphtalénique en vue de l'obtention d'insecticides.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 117–132, refs. Heverlee [? 1947].

The author reviews the methods by which the molecules of organic compounds react with chlorine, and describes the chlorination of benzene and naphthalene by substitution and by addition, and of phenol and the cresols by substitution, the synthesis of DDT, and the production of nitro- and chlor-derivatives of DDT. He discusses the contact action of the insecticides formed by these methods and concludes that mono-substituted derivatives of benzene and naphthalene are more toxic than the original compounds, and that the degree of toxicity depends on the radical introduced, the CH_3, NH, NO and OH radicals being increasingly effective. Di- or tri-substituted compounds are generally more toxic than mono-substituted ones, and those with two different radicals than those with two similar ones. Combinations of two or more benzene rings or derivatives of them are more toxic than single ones. Iodine, bromine and chlorine derivatives are decreasingly effective. It has been shown experimentally that the chlorination of benzene or naphthalene by addition or substitution results in insecticidal compounds, the insecticidal properties generally increasing with the percentage of chlorine, and the para position being most favourable for dichlor-derivatives ; that the introduction of the NO_2 radical into a chlorine derivative increases its insecticidal effect ; that the structural arrangement of the compound has a considerable influence on its activity ; and that the insecticidal action of the different products is specific for certain groups or species of insects.

It is pointed out that, upon chlorination, toxicity increases from mono-chlorbenzene to dichlorbenzene and is greatest for benzene hexachloride (hexachlorcyclohexane) ; that chlorination of phenol produces trichlorphenol and pentachlorphenol, both of which are very active ; that the derivatives of

cresol have a powerful insecticidal action, but also a caustic effect ; that the substitution compounds of naphthalene are very toxic to both insects and mammals ; and that the addition compounds of naphthalene, though less active, give rise to interesting nitrated derivatives, which are being studied. It is also emphasised that the chlor- and nitro-derivatives of DDT are very effective.

GONGGRIJP (J.). **Het gebruik van dichloor-diphenyl-trichloorethaan (D.D.T.) in combinatie met minerale olie en di-nitro-orthocresol (D.N.O.C.) als winterbestrijdingsmiddel.** [The Use of DDT in Combination with Mineral Oil and Dinitro-o-cresol as a Winter Spray.]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 145–158, 8 refs. Heverlee [? 1947].

An account is given of laboratory and field tests in Holland in 1944–46 designed to ascertain whether the effectiveness of winter-spray preparations against insect pests of fruit-trees could be increased by combining them with DDT. The materials compared included stock emulsions (W-U C 1, W-U C 2 and W-U 117) of mineral oil containing dinitro-o-cresol and 1, 2 and 0 per cent. DDT, respectively, and a tar-distillate emulsion (fruit-tree carbolineum) ; these were used at concentrations of 6 per cent. in the orchard tests and 4 or 6 per cent. in the laboratory.

In laboratory tests with *Operophtera brumata*, L., in 1943–44, eggs laid on twigs by females from a cherry orchard were sprayed on various dates from December to early March. W-U 117 gave complete mortality on nearly every date, while W-U C 1 and 2 were somewhat erratic ; the effectiveness of the tar distillate declined with the lateness of the application [*cf. R.A.E.*, A **31** 377]. In practice, however, W-U 117 does not normally give complete mortality of eggs of *O. brumata*, and, in orchard tests in March-April 1944 and March 1946, it was much less effective than W-U C 2, probably owing to the prolonged action of the DDT deposit.

In orchard tests, against the larvae of Tortricids, including *Spilonota ocellana*, Schiff., *Tortrix* (*Cacoecia*) *lecheana*, L., *T.* (*C.*) *podana*, Scop., *T.* (*Capua*) *reticulana*, Hb., and *Argyroploce variegana*, Hb., W-U C 2 was more effective in nearly every case than W-U 117 or tar distillate ; it was also more effective against *Coleophora* (*Eupista*) *fuscedinella*, Zell., and *Chloroclystis rectangulata*, L. Following laboratory experiments in which mineral-oil emulsions, dinitro-o-cresol and W-U C 2 were highly toxic to adults of the apple blossom weevil (*Anthonomus pomorum*, L.), but tar distillate was not, orchard experiments against them were carried out in 1944 and 1946. The sprays were applied in March or early April, and W-U C 2 gave the best control, with local variations in effectiveness, followed by W-U 117. W-U C 1 and 1 per cent. Arkotine (a spray material containing 5 per cent. DDT) also gave good results in single tests. The effectiveness of W-U C 2 increased the later it was applied, and the condition of the foliage of the trees sprayed with it was better than would have been expected from the degree of infestation, probably because less feeding occurred than on trees that received the other treatments. In June 1945, fewer larvae of *Hyponomeuta padellus malinellus*, Zell., were found on trees sprayed with W-U C 2 than on those sprayed with W-U 117, and these were smaller and had consumed much less food.

Field tests indicated that the addition of DDT to dinitro-o-cresol and oil emulsion had little adverse effect on the control of Aphids or *Paratetranychus pilosus*, C. & F. (*Metatetranychus ulmi*, auct.), and it is concluded that the combination of the three ingredients gives a very effective winter spray, particularly when applied late in the season, and controls a greater number of orchard pests than any other.

West (T. F.). **Mode of Action of newer synthetic Insecticides.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 193–197, 13 refs. Heverlee [? 1947].

The author reviews hypotheses as to the mode of action in insects of DDT [*cf. R.A.E.*, A **35** 203], and states that although the mode of action of chlordane (1068) has not been dealt with in publications, he is under the impression that the investigations that led to its discovery [**35** 119] were suggested by one of these hypotheses [**34** 255]. Reference is made to experiments [on an ascomycete] that have supported the suggestion that the γ isomer of benzene hexachloride is taken up by the organism and gains general access to its cells because this isomer is molecularly very similar to inositol [**33** 257 ; but *cf.* **36** 175].

Soenen (A.). **Un nouveau genre de parasites sur nos pommiers.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 211–217. Heverlee [? 1947].

Fruit trees in Belgium are attacked by various Lepidoptera that are primarily pests of forest trees. In 1946, apple in Limbourg was severely damaged by the Noctuids, *Cosmia* (*Calymnia*) *pyralina*, Schiff., and *C.* (*C.*) *trapezina*, L., the larvae and adults of both of which are described. Both have previously been recorded in Belgium on elm and oak, and *C. trapezina* also on poplar, willow and birch. Since the larvae were found in association with those of *Operophtera brumata*, L., which they closely resembled, and the damage they caused was very similar, it is thought that they may have been responsible for much of the injury attributed to the Geometrid in previous years. They were more numerous and more injurious than *O. brumata* in many orchards. They attacked the foliage and shoots, and *C. pyralina* also partly consumed many young fruits.

The larvae of *O. brumata* hatch in March, feed on buds, shoots, flowers and leaves and become full-fed in mid-May, when they pupate in cocoons in the soil, giving rise to adults in October. Those of the two species of *Cosmia* hatch early in April and are full-fed in early June ; they do not spin cocoons and generally pupate in the soil, though some do so under the bark of trees and occasionally among the foliage. In the laboratory in 1946, the adults emerged from 19th to 30th June ; in the field, the first adults were found on 27th June. It is not known where the eggs are deposited, but any on the bark would doubtless be destroyed by normal winter sprays ; arsenical sprays applied in spring would probably control the larvae.

Bonnemaison (L.). **L'anthonome du poirier.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 227–233, 4 refs. Heverlee [? 1947].

Anthonomus piri, Koll., has become increasingly injurious to pear in France since about 1930 and caused serious damage in 1940–43. Observations on its bionomics near Paris showed that the adults emerge from mid-April to the end of May, feed on the young leaves and shoots until mid-June and then aestivate in cracks in the bark or soil or beneath stones or grass. They return to the trees during September, all having done so by 20th–25th, and feed on the petioles and the lower parts of the leaf buds. They pair 5–10 days after resuming activity, and the eggs are inserted into the fruit buds some five days later and covered with a protecting secretion. The average number of eggs per female does not exceed 20. The larvae hatch from late December to mid-February [*cf. R.A.E.*, A **34** 362], feed within the fruit buds and pupate from the end of March.

The weevil is best controlled by treatment against the adults after they have emerged from aestivation and before they have oviposited, and experiments in 1943–45 indicated that the most effective time was during the second half of September. Various treatments were compared in 1944 and 1945, the

dates of application being 28th and 18th September, respectively. In 1944, the percentages of buds destroyed by the larvae were 3·8, 46·8 and 56·7 for sprays of 0·05 per cent. DDT, 0·1 per cent. benzene hexachloride and 2 per cent. lime-sulphur (36° Bé), all with a wetter, and 9·3, 52·8 and 73·8 for dusts of 5 per cent. DDT, 5 per cent. benzene hexachloride and 1 per cent. dinitro-o-cyclohexylphenol, respectively, as compared with 83 for no treatment. In 1945, when only sprays were tested, they were 3·8 for 0·05 per cent. DDT, 13·4 for 1·5 per cent. of a 10 per cent. solution of polychlorcyclane sulphide in vegetable oil, 19·8 for 0·15 per cent. benzene hexachloride, 36 for 2 per cent. summer-oil emulsion (83 per cent.) 38·4 for 0·04 per cent. dinitro-o-cyclohexylphenol, 6 for 1·35 per cent. phenothiazine (thiodiphenylamine) and 38·2 for 2 per cent. of a product containing 0·4 per cent. pyrethrins, as compared with 46·4. It is recommended that a large quantity of spray should be applied to all parts of the trees, the liquid that falls to the ground serving to destroy any weevils that abandon the trees. Since, on late pears, the spray is applied before harvesting, the use of materials that impart an unpleasant odour to the fruit should be avoided. In view of the low egg-production of the weevil, one treatment every 3–5 years should be sufficient.

SAUVAGE (F.). **L'hexachlorocyclohexane, insecticide d'avenir.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 237–244, 2 figs. Heverlee [? 1947].

The author reviews the chemical composition of benzene hexachloride, the diverse toxic properties of the four known isomers and the paralytic effect of the compound on insects, and gives graphs showing its toxicity and that of DDT to various insects and to Crustacea. It has been used with success in Belgium as a dust against several insects, including thrips on grape vines in glasshouses and *Hylemyia* (*Chortophila*) *brassicae*, Bch., *Plutella maculipennis*, Curt., and flea-beetles on cabbage, but has given conflicting results against Aphids. The respective advantages of sprays and dusts are compared, and the toxicity of the γ isomer to warm-blooded animals is briefly discussed.

BLATTNY (C.). **Notes sur l'efficacité du D.D.T.-Gesarol.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 247–250, 4 figs. Heverlee [? 1947].

The results are given of three series of tests with DDT in Czechoslovakia. In the first, contact with DDT dusts proved more toxic to several species of insects at temperatures of the order of 20–25°C. [68–86°F.] than at lower ones, and in the second, dusts and sprays gave good control of unidentified thrips and *Apion* spp. on *Lotus corniculatus*. In the third, 50 adults of *Leptinotarsa decemlineata*, Say, which is a serious pest in Czechoslovakia, were dusted and sprayed ; 49 died in a few days, but the other one survived repeated treatments with sprays and dusts.

HALLEMANS (A.). **Recente opzoekingen en proefuitslagen over den bloemknopafsteker der aardbeien** (*Anthonomus rubi* **Herbst**) **en** *Cladius pecticornis* **Geoff, schadelijk aan aardbeien.** [Recent Investigations and Results of Tests on the Strawberry Bud Weevil (*A. rubi*) and *C. pectinicornis*, which damages Strawberries.]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 251–263, 7 figs. Heverlee [? 1947].

Notes based on recent observations in Belgium are given on the bionomics and control of the weevil, *Anthonomus rubi*, Hbst., and the sawfly, *Cladius pectinicornis*, Geoffr., which are injurious to strawberry, and their larvae and adults are briefly described. *A. rubi*, which has also been found on raspberry, loganberry, rose and wild rosaceous plants, sometimes destroys 20–30 per cent.

or more of the flower buds of strawberry; its life-history is similar to that already noticed [*R.A.E.*, A **18** 694; **19** 611]. The overwintered adults normally appear in late April or early May and feed for about a fortnight before pairing and ovipositing. They were most active and injurious at day temperatures of 18–20°C. [64·4–68°F.]. Owing to the variation in the rate of growth of the plants, control measures are best timed in accordance with the appearance of the adult weevils, and were most effective when applied immediately the adults appeared, and, if necessary, about a week later. Following preliminary tests with nicotine and DDT in 1944 and 1945, in which the effect of nicotine was not lasting enough to be of value, further experiments were made with DDT in 1946, and the results showed that both dusts and sprays gave very good control, two timely applications of the former affording complete protection as compared with 20–30 per cent. of the buds severed in the controls. Similar, but less important, damage is caused by *Rhynchites germanicus*, Hbst. [*cf.* **30** 324], the adults of which appear about mid-April and could be controlled by dusting with DDT during the first half of the month.

C. pectinicornis had two generations a year [*cf.* **17** 676; **20** 344] and also occurred on raspberry and *Spiraea ulmaria*. Young larvae were observed on strawberry under glass as early as 10th April in two consecutive years. They live in groups, mostly on the undersides of the leaves, which they skeletonise, and become full-grown in the second half of May. Adults of the first generation were observed in early June, and some second-generation larvae on 10th June, though they normally hatch during the second half of the month. Control measures should be applied as soon as the larvae begin to skeletonise the leaves. One application of a nicotine spray or a DDT dust gave excellent control, but DDT as a dust or, possibly, as a spray, is considered preferable against the first generation, since it also controls *A. rubi*.

HALLEMANS (A.). **De bladnerfafsteker der fruitboomen,** *Rhynchites pauxillus* **Germ.** [*R. pauxillus* on Fruit Trees.]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 265–269, 5 figs. Heverlee [? 1947].

The adults and larvae of *Rhynchites pauxillus*, Germ., and the injury they cause to fruit trees [*cf. R.A.E.*, A **25** 386] are briefly described. They occur on various fruit trees in Belgium, but chiefly on apple. The adults appeared on the trees in April and pairing was observed between mid-April and the end of May. The injury caused by the larvae is often unimportant, although the main branches of young apple trees were sometimes almost completely defoliated. Control measures should be applied as soon as the weevils begin their maturation feeding, preferably on warm, sunny days. Tests with DDT dusts and sprays showed that the former were more effective. The tops of the young shoots should be thoroughly treated, one application being sufficient unless the dust is washed away by rain within a few days. A spray of 0·4 per cent. lead arsenate gave little control, since the weevils did not feed sufficiently on the leaf-blades to ingest a lethal dose.

CLAUSEN (R.) & GÜNTHART (E.). **Essais de lutte contre le ver blanc** (*Melolontha melolontha* **L.**) **avec l'hexachlorocyclohexane.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 289–293. Heverlee [? 1947].

In preliminary tests in Switzerland in May 1944, third-year larvae of *Melolontha melolontha*, L., were rapidly killed when a liquid containing benzene hexachloride was sprinkled over the soil. In systematic tests, begun on 28th August 1945, in meadows in the canton of Aargau infested by over 200 first-year larvae per sq. yard to a depth of just over an inch, an aqueous suspension prepared from a proprietary powder ("941") containing 13 per cent. benzene

hexachloride in inert material was poured over the light, sandy soil at the rate of 0·3 or 0·6 oz. active ingredient per sq. yard. The liquid penetrated rapidly, and both rates gave over 90 per cent. mortality in a few days to a depth of 16 ins. when the amount of liquid applied per sq. yard was 15 pints, but less when it was 7·5 pints. On the same date, the powder was scattered into ploughed furrows about 6 ins. deep, at rates of about 0·08, 0·16 or 0·32 oz. active ingredient per sq. yard ; a fortnight later, the control percentages as compared with untreated soil were 57, 84 and 89 respectively, and even the lowest rate was subsequently found to keep the soil free from larvae until the following year.

In further tests, liquids containing 0·7–1 per cent. benzene hexachloride were applied to various types of soil planted with fruit trees, currants, vines, vegetables and other plants, and also to meadows and lawns. The liquid was poured, sprayed or sprinkled over the soil, or, in the case of fruit trees and bushes, poured into a hollow surrounding the trunks or stems, or, in nurseries and vineyards, into trenches along the rows. The effectiveness of the treatment was not affected by the type of soil, provided that it was permeable, but the liquid penetrated very slowly in fine silt and the solids in the suspension were left on the surface ; this difficulty was avoided by using the benzene hexachloride in an emulsified solution, but care has to be taken to avoid emulsifiers that may scorch the plants. In all cases the treatments gave rapid mortality, amounting to 90 per cent. or more, of first-, second- or third-year larvae, and ensured freedom from subsequent damage, since the larvae that survived disappeared some months later. When 1 per cent. benzene hexachloride (0·2 oz. active ingredient per sq. yard) was applied to the roots of nursery stock soon after the appearance of the adults, females that entered the soil were found paralysed about an inch below the surface and oviposition appeared to have been checked ; no injury was subsequently sustained by these trees, although those in neighbouring plots were seriously damaged.

Plants in treated soil were not injured by the insecticide except in the few instances cited. Two days after its application at 0·08 oz. per sq. yard to the roots of young cherry trees newly transplanted into heavy clay soil, chlorosis of the foliage and partial leaf-fall were observed and growth was checked to some extent. The treatment also checked the growth of young fruit trees that had been slightly injured by the larvae. A lawn, treated at the rate of 0·4 oz. per sq. yard three weeks after it had been laid, developed excellently but contained no clover, and certain fine grasses disappeared ; the turf could be easily removed, and the roots, which were partly brown, appeared unable to penetrate more than about ½ in. into the soil. When 0·4–0·6 oz. benzene hexachloride per sq. yard was applied to root crops, the odour persisted in carrots, radishes and potatoes, but the fruits of strawberry plants treated six weeks before maturity were not tainted.

In the subsequent discussion (p. 294), R. Gallay reported that in his experiments some larvae of *M. melolontha* were not killed by soil treatment with benzene hexachloride, but penetrated deeper into the soil. Crespy stated that in tests carried out in France, dusts containing 8 per cent. technical benzene hexachloride, applied to the soil at 0·12 oz. technical product per sq. yard, protected beets, carrots and swedes sown 12–15 days after treatment from attacks by third-year larvae, and also protected young conifers transplanted a fortnight after treatment.

Burnet (I. M.) & Holmes (E.). **Gammexane as an agricultural Insecticide.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 295–303. Heverlee [? 1947].

The authors review the history of the discovery of benzene hexachloride, the properties of its various isomers, its toxicity to mammals and its mode of

action [*cf. R.A.E.*, A **33** 256–258] and give an account of the use of Gammexane (the γ isomer of benzene hexachloride) against various insects, some of which have already been noticed [*cf.* **33** 257 ; **34** 256]. Experiments in England against wireworms (*Agriotes*) have shown that economic control on crops such as cereals and beet can be obtained with Gammexane applied as a diluted dust before sowing, and that this treatment will ensure almost complete establishment of grass seeds in pastures under conditions of wireworm attack. Field sampling carried out in two autumn trials about six months after treatment, and in four other fields sown in spring at about 6–8 weeks, showed that in no case had any significant reduction in wireworm population occurred as a result of treatment, although there were very distinct differences in plant population. It appears from preliminary investigations that the wireworms are inactivated by the compound and prevented from attacking the plants, and large numbers of them have been found on the surface soon after treatment, apparently unable to enter the soil and feed ; they are probably killed by desiccation. There is apparently no relation between the wireworm population as shown by sampling and the attack that develops ; a population of over 1,000,000 per acre does not always prevent a good yield, even of susceptible crops such as oats, whereas a moderate population of about 600,000 per acre may result in serious attack [but *cf.* **33** 265].

Successful results have also been obtained against many other agricultural insect pests, but the compound has not proved very effective against Aphids or Tetranychid mites. It should not be applied to the soil in which potatoes, onions or carrots are grown or to soft fruits that are to be harvested within 2–3 months, on account of possible tainting.

GÜNTHART (E.). **Lutte contre les insectes exerçant leurs ravages à l'intérieur des plantes crucifères.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 305–314, 6 figs., 1 ref. Heverlee [? 1947].

The results are given of further work in Switzerland on the use of benzene hexachloride against *Ceuthorrhynchus* spp. and *Psylliodes chrysocephala*, L., on cruciferous crops [*cf. R.A.E.*, A **35** 385], together with some notes on their bionomics. The effectiveness of the insecticide in killing the eggs and larvae within the plants, as well as the adults, was confirmed. A suspension of benzene hexachloride gave better results against *C. pleurostigma*, Marsh., and *C. quadridens*, Panz., on cabbage than one of DDT, and cauliflower transplants were protected against *C. quadridens* by dipping the aerial parts in a suspension of 0·13 per cent. technical benzene hexachloride before planting them out or spraying them with it afterwards. Better results were obtained when the plants were sprayed from below upwards as well as from above downwards, and an emulsified solution containing 0·05 per cent. γ benzene hexachloride was even more effective as a spray than the suspension. These sprays also controlled *C. pleurostigma* on cabbage, as did dusts when the concentration of benzene hexachloride was high. Two applications in spring gave good results against *C. napi*, Gylh., and *C. quadridens* on rape and more than doubled the yield, and one in autumn gave almost complete mortality of larvae and adults of *P. chrysocephala* on the same crop.

Benzene hexachloride also proved effective against larvae of *Phytomyza rufipes*, Mg., which mine the leaves and stems of cabbage transplants, and against *P. lateralis*, Fall., in carrot. It affords protection against larvae of *Hylemyia cilicrura*, Rond., which mine the cotyledons of beans in the soil.

No plant injury was caused by repeated treatments with dusts or suspensions of benzene hexachloride, and the relatively short residual action of the insecticide is advantageous in that fewer natural enemies of the pest it is desired to control are destroyed than is the case with compounds that leave

highly toxic residues. Two months after the application in May 1945 of suspensions of 0·05–0·1 per cent. DDT or 0·1–0·2 per cent. benzene hexachloride to a hedge of *Carpinus betulus* against Lamellicorn beetles there were 200 adults of *Tetranychus* (*Eotetranychus*) *carpini*, Oudm., per leaf on the parts treated with DDT and 8–9 on those treated with benzene hexachloride, as compared with 13 for no treatment. The natural enemies of the mite present comprised chiefly larvae and adults of the Coccinellid, *Stethorus* (*Scymnus*) *punctillum*, Weise, a few individuals of the Anthocorid, *Orius minutus*, L., and occasional larvae and adults of the Staphylinid, *Oligota* sp.

ZOBRIST (L.). **Nouvelles expériences dans le domaine de la protection des plantes ornementales.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 319–325, 6 figs. Heverlee [? 1947].

Tests carried out over several years in greenhouses in Switzerland have shown that complete control of many pests of ornamental plants, including Coccids, *Tetranychus telarius*, L. (*urticae*, Koch), the Aleurodid, *Trialeurodes vaporariorum*, Westw., and thrips, particularly *Heliothrips haemorrhoidalis*, Bch., can be obtained with a spray containing 0·2 per cent. of a rotenone preparation and 0·3 per cent. kerosene. Plants heavily infested by Coccids should be sprayed 2–3 times at intervals of 4–6 days and subsequently at monthly intervals, or, when free from infestation, with 0·4 per cent. of the rotenone preparation only as a preventive measure. The kerosene and rotenone spray can be safely applied to nearly all greenhouse plants except poinsettia (*Euphorbia pulcherrima*) and ferns, especially *Adiantum cuneatum*, *Nephrolepis exaltata* and *Pteris cretica*, but cacti and other plants with waxy leaves should be treated with rotenone dust only.

A spray containing 0·3 per cent. copper carbonate and 0·4 per cent. of a rotenone preparation, which can be safely applied to all greenhouse plants, including begonias in full bloom, gives simultaneous control of thrips, mites, Aphids, eelworms, and many injurious fungi. As a control measure it should be applied twice at an interval of 4–6 days and subsequently every 3–4 weeks, but monthly treatments are sufficient for preventive purposes. On roses, this spray is widely used for the control of fungi and of *Macrosiphum rosae*, L., *Tetranychus telarius*, several species of thrips, *Typhlocyba rosae*, L., and the larvae of various Tortricids; it should be applied before the flowers appear, and applications can be continued at intervals of three weeks, as it does not injure the blooms, except those of exceptionally sensitive varieties that are injured by copper compounds. A dust containing sulphur, copper and derris, applied lightly at intervals of one week, is almost as satisfactory as the spray, but is less effective against rust and Tetranychids.

VERCAMMEN-GRANDJEAN (P. H.). **De la destruction continue, par voie mécanique, des insectes parasites des graines, de leurs produits et sous-produits.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 327–335, 2 figs. Heverlee [? 1947].

The author describes a machine (the Entoleter) that has proved effective in tests in the United States and England for the mechanical destruction of insects and their eggs in wheat and flour [*cf. R.A.E.*, A **34** 180]. It consists essentially of two circular horizontal steel plates joined together close to their edges by two rows of short steel bars. An opening in the upper plate admits a conical distributor down the outside of which the grain runs. The distributor and the plates are rotated as a unit by a motor at a speed suitable for the product being treated, and as the distributor revolves, the grain is flung by centrifugal force between the plates, against the steel bars and out to the side

walls of the apparatus, from which it falls through an outlet beneath. The grain itself is not damaged by the treatment. The material is fed into the machine through one or two pipes, two being more satisfactory for heavy products, and pressure that is set up in the machine in action is relieved by a pipe that allows the air to pass into the entry pipe from a pressure chamber at the outlet.

HERINGA (J. W.). **Onderzoek naar een vervangingsmiddel voor calomel ter bestrijding van de uienvlieg.** [Research to find a Substitute for Calomel for the Control of the Onion Fly.]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 337–350, 2 figs., 2 graphs. Heverlee [?1947].

This is an account of preliminary work in Holland to find material more readily available than mercurous chloride (calomel) for seed treatment against the onion fly, *Hylemyia antiqua*, Mg. [*cf. R.A.E.*, A **36** 270]. Notes are given on the bionomics of the fly [*cf.* **34** 92]. In laboratory tests of various substances, DDT, naphthalene and naphthenic acids proved the most toxic to the larvae, and DDT and naphthalene did not reduce the germination of onion seeds to which they were applied. Mercurous chloride appeared to stimulate germination, but was not highly toxic to the larvae in the laboratory. Various bacteria and probably non-parasitic moulds were cultured from onion plants that failed to develop, and when females of *H. antiqua* were offered healthy and decaying onion bulbs for oviposition, they preferred the decaying ones. Mercurous chloride, mercuric chloride (corrosive sublimate) and a reaction product of naphthylamine proved toxic to the bacteria responsible for the decay, but naphthalene, DDT, phenothiazine and naphthylamine did not. When eggs of *H. antiqua* that had been sterilised with 0·1 per cent. mercuric chloride were placed on pieces of onion bulb that were either sterile or smeared with bacteria from the dead plants, the larvae that hatched appeared to develop better when the bacteria were present than when they were not. It is concluded that the bacteria play an important part in the development of the larvae, and that the control afforded in practice by mercurous chloride may be due to its bactericidal rather than to its insecticidal properties.

In a preliminary field test, onion seed was moistened with a glue solution, mixed with an equal weight of mercurous chloride or naphthalene, half its weight of DDT, or 3 per cent. of its weight of a proprietary bactericide (Ceresan-nieuw) and sown at a suitable rate. Subsequent inspection showed that mercurous chloride and DDT both gave very good protection from infestation, as compared with no treatment, and naphthalene none, while the bactericide appeared to have increased the injury. Still later inspection showed that plants from seed treated with DDT were practically uninfested. In a second test, in which a mixture of naphthalene and 0·5 per cent. naphthylamine was also included, the weight of the harvested crop was doubled and trebled, respectively, as compared with no treatment, by mercurous chloride and DDT, little affected by naphthalene, alone or with naphthylamine, or the bactericide, and somewhat reduced by broadcasting the mixture of naphthalene and naphthylamine over the ground when untreated seed sprouted.

EMERY (G. A.). **Some recent Experiments in the Use of synthetic Insecticides.** —*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 351–358. Heverlee [? 1947].

This paper, which deals mainly with recent work in England on the effectiveness of DDT against various insects, also includes an account of preliminary experiments with sprays of azobenzene, some of which have already been noticed [*cf. R.A.E.*, A **35** 189–190]. A wettable powder, prepared by grinding the dried crystalline material with four times its weight of china clay and

suitable wetting agents and applied in a spray at concentrations of 0·05 and 0·1 per cent. actual azobenzene to tomato, cucumber and french beans grown under glass and heavily infested with red spider [*Tetranychus telarius*, L.], caused no damage and gave very satisfactory control of mites and eggs, with almost complete mortality of the younger mites, although it had very little effect on mature females. When leaves bearing eggs were kept in the laboratory for 14 days, there was 5–10 per cent. hatch on those sprayed with 0·05 per cent. azobenzene and 1–2 per cent. on those sprayed with 0·1 per cent., as compared with 75 per cent. over a period of 2–10 days on the controls. The 0·1 per cent. spray caused no injury to rose, carnation, vines and *Hydrangea*, all under glass, or to plum trees, but completely defoliated apple trees, the leaves of which turned brown after five days and dropped after a further two, although the fruit was not scorched and did not drop. On some other varieties of apple, the effect appeared after three weeks. The spray was unsatisfactory for application to fruit trees or ornamental plants, owing to the unsightly deposit of china clay.

The value of DDT for the control of *Plesiocoris rugicollis*, Fall., on apple [*cf.* **35** 27] was confirmed by detailed experiments in 1946. The results, typical examples of which are given in a table, showed that in every case DDT was far more effective than the standard petroleum oil spray, giving complete control in several instances, and it is concluded that, to obtain maximum protection, two applications of a spray containing DDT (0·1 per cent. as a wettable powder) should be made, the first at the bud-burst stage and the second at the green-bud or pink-bud stage, although considerable control is given by a single application at the green-bud or pink-bud stage. If control of the apple blossom weevil [*Anthonomus pomorum*, L.] is also required, an application of DDT at bud burst is essential, and it can be combined with a dinitro-o-cresol or thiocyanate spray; the second application should be combined with the routine spray against scab [*Venturia inaequalis*].

Following preliminary experiments in 1945, field trials were carried out in 1946 on the control of the black-currant leaf-curling midge, *Dasyneura tetensi*, Rübs. In two tests, one application of a spray of wettable DDT powder (0·1 per cent. DDT) on 1st or 18th April gave 87·4–81·7 and 90·7–86·6 per cent. control, respectively, while two applications, on 1st and 16th April, gave 96·6–99·2 per cent. In a third test, the same spray and an emulsion of a 5 per cent. solution of DDT in white oil (0·025 per cent. DDT), applied on 8th April, gave 67·4 and 77·7 control, respectively, as compared with only 32·9 per cent. for three applications, on 27th and 29th March and 1st April, of an 8 per cent. emulsion of petroleum oil containing dinitro-o-cresol. The value of DDT in controlling the midge is considered conclusive, although in another test the difference between sprayed and unsprayed bushes was barely significant.

Experiments were begun in 1946 to ascertain whether Coccids could be controlled with an aqueous suspension of DDT, which would be of value on plants that do not tolerate an oil spray. Preliminary results indicated that a paste containing 50 per cent. DDT in a very finely divided state, and no other insoluble material, diluted to contain 0·1 per cent. DDT, with a high rate of wetting agent, was almost as effective as 0·025 per cent. DDT in emulsified oil.

Experience on the control of the mushroom flies (*Sciara* spp.), has shown that, once the buttons have appeared above the surface, even watering with plain water marks them, but that marking does not occur if a wetting agent is added. Experiments with the 50 per cent. DDT paste indicated that spraying the beds and the whole inner surface of the house with a wash containing 0·04 per cent. DDT and a wetting agent gives a very high degree of control.

Discussing the possible harmful effects of DDT on man, the author points out that, although it was used on a very large scale in England in 1946 and applied under a great variety of conditions with no particular precautions, no instance of ill effects came to his knowledge other than a slight, temporary nausea caused by inhaling large quantities of 5 per cent. DDT dusting powder that was much less marked than that caused by derris. No noticeable reduction of beneficial insects on apple trees occurred where DDT was applied in the pre-blossom stage, but its use in the post-blossom stage should be avoided until late in July, when it is too late for a serious infestation of Tetranychids to develop.

Brief experiments were carried out at the end of May on the control of *Lymantria dispar*, L., on cork oak [*Quercus ilex* var. *suber*] in Portugal, in which sprays prepared from a 20 per cent. wettable DDT powder (0·05 per cent. DDT) and an emulsion of a 5 per cent. solution of DDT in white oil (0·025 per cent. DDT) were tested. Although heavy rain fell immediately after spraying, a striking reduction in infestation was obtained. Two days after treatment, there was a heavy and uniform population of larvae on unsprayed trees, many of them descending on silk threads, while on the sprayed trees there were extremely few larvae on the foliage, and some that were crawling up the trunks were thought to have migrated from unsprayed trees. When larvae collected from the trunks of sprayed and unsprayed trees were placed on clean foliage and examined two days later, none from the unsprayed trees had died, 80 per cent. of those from the trees sprayed with the emulsion were dead and the rest moribund, and no feeding had occurred, and 80 per cent. of those from the trees sprayed with wettable DDT were dead, 10 per cent. were moribund, and the rest were active ; these last were all large individuals and had probably not been on the trunks for more than a few minutes.

Besemer (A. F. H.). **Expériences acquises aux Pays-Bas par l'emploi de nouveaux produits et de nouvelles méthodes de lutte contre les maladies des plantes pendant la guerre et depuis la libération du territoire.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 373–386. Heverlee [? 1947]. (Also in Dutch, pp. 359–372.)

The author reviews the functions of various organisations concerned in the prevention and control of pests and dieases of plants in Holland and the new materials and methods of control employed there of recent years. Valuable assistance is afforded to growers by information services, which co-ordinate reports from scientific observers and inform those concerned, by wireless, the press or personal communication, when precautions or control measures should be undertaken against a given pest or disease in a particular locality ; among the pests thus dealt with are *Anthonomus pomorum*, L., on apple, *A. piri*, Koll., on pear, the fruit-tree red spider, *Paratetranychus pilosus*, C. & F. (*Metatetranychus ulmi*, auct.), *Hoplocampa minuta*, Christ, on plum, and *Contarinia nasturtii*, Kieff. (*torquens*, de Meij.), on cabbage [*cf. R.A.E.*, A **27** 514].

DNC (dinitro-o-cresol) and its salts have largely replaced tar distillates (carbolineums) as winter sprays on fruit trees, and experiments have shown that their effectiveness increases as the temperature and humidity rise, and that they are best applied just before the eggs of Aphids and other insects hatch [*cf.* **36** 111–112]. Owing to shortage of labour in recent years, they have sometimes been applied when it is too late for them to be of value, and wireless announcements that the eggs of Aphids have hatched have therefore been made.

In some parts of Holland, where large areas of apple and pear are interplanted with currants, the currants are seriously damaged by *Incurvaria capitella*, Cl., which destroys the buds and young shoots. It can be effectively

controlled by spraying during the second half of January with tar distillate or DNC, preferably the former, as DNC is not sufficiently effective against the eggs of Aphids and other insects at this time.

Considerable damage to apple is sometimes caused by *A. pomorum*, particularly in old-established fruit-growing areas and in those near woods [*cf.* **34** 93], but it has recently been found that the damage can be eliminated by spraying with DDT before the oviposition period, namely at the bud-burst stage on most varieties or at the swelling stage on later ones. Benzene hexachloride has not given such good results as DDT. Spraying with DDT in autumn gives good control of *A. piri*, which is very injurious to pear in some localities, particularly in Limburg and Zeeland.

H. minuta is a serious pest of plum, particularly in Beemster and Bangert. Of the sprays employed, the most effective contains enough derris to give a rotenone content of 1 : 7,500 ; DDT has also been effective, but nicotine and nicotine sulphate have not. Spraying should be begun as soon as the larvae hatch, and repeated, if necessary, 10–12 days later. Damage to apple by *H. testudinea*, Klug, is extremely serious in Zeeland, West Brabant, Betuwe, Utrecht and North Holland ; in one orchard, sprayed trees yielded more than 11 times as much fruit as unsprayed ones. The most satisfactory control is obtained with sprays of derris or nicotine, applied when about 15 per cent. of the larvae have hatched ; if necessary a second treatment is applied when the young larvae are migrating to other fruits. Less favourable results have so far been obtained with benzene hexachloride and DDT. In one locality, important damage to pear is caused by *H. brevis*, Klug, which has not been satisfactorily controlled by the treatments employed against the other species of *Hoplocampa* ; in one instance, excellent results were obtained with a benzene-hexachloride dust.

For the control of *C. nasturtii*, which in 1945 reduced the crop of headed cabbages in Holland by 60 per cent., information on the two main flights of adults is obtained from emergence cages [*cf.* **26** 466], and five announcements relating to the application of sprays are made. The most effective sprays contain pyridine and soap or nicotine and soap, and these are applied at high pressure to the hearts of the cabbages at intervals of not more than four days during the appropriate periods. Another cabbage pest about which announcements were made in 1946 was *Plutella maculipennis*, Curt. ; it was most effectively controlled by dusts and sprays of DDT, and benzene hexachloride was also of value.

Van den Brande (J.). **Schade van de fritvlieg, *Oscinella frit* L. aan de graanopbrengst (met proeve van bestrijding).** [Loss in Grain Yield caused by the Frit-fly, *O. frit* (with a Control Experiment).]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 387–392, 1 fldg. table, 2 refs. Heverlee [? 1947].

Tables are given showing the effect of infestation by *Oscinella frit*, L., of 15 varieties of oats grown in experimental plots in Belgium in 1945. Infestation of spikelets varied from 11·67 to 51·7 per cent., and loss of weight at harvest from 2·8 to 10 per cent., but high infestation was not always associated with high loss of weight. Although DDT gave complete mortality of the adults in the laboratory, up to four applications of DDT sprays in the field did not reduce infestation.

Van den Brande (J.). **De gevoeligheid van ritnaalden voor oplosbare maaggiften.** [The Susceptibility of Wireworms to soluble Stomach Poisons.]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 393–397, 1 ref. Heverlee [? 1947].

An account is given of laboratory tests in Belgium to ascertain the toxicity of solutions of strychnine, mercuric chloride, potassium arsenate or arsenic

trioxide to wireworms of the genus *Agriotes*, to which the vast majority of those collected in the field were found to belong. Groups of three wireworms were confined in petri dishes, 10 cm. in diameter, of which some were empty and others filled with humus (dried leaf mould) or sand, and 10 or 20 cc. solution was applied in each dish. In most cases, mortality was most rapid in empty dishes and slowest in sand, but strychnine, even at a concentration of 1 per cent., had no effect whatever [*cf. R.A.E.*, A **36** 175]. In empty dishes, 0·1 per cent. mercuric chloride gave complete mortality in 3 days ; in humus, complete mortality was obtained in 16, 20 and 22 days with 20 cc. of 0·2 and 0·1 per cent. solutions and 10 cc. of 0·2 per cent. solution, respectively. Potassium arsenate (for which the amount of solution applied is not stated) gave no mortality in a month in humus or sand at concentrations of 0·1, 0·2 and 0·4 per cent. At 0·5 and 1 per cent. it gave complete mortality in 5 and 3 days in humus, 13 and 13 days in sand and 27 and 7 days in empty dishes. In the case of arsenic trioxide, complete mortality in 2 days in both empty dishes and humus was obtained with 10 cc. of 0·1 per cent. solution and with 20 cc. of 0·04 and 0·08 per cent. solutions, though 9 and 13 days were required in humus with 20 cc. of 0·03 and 0·02 per cent. solutions.

It is concluded that the supposed resistance of wireworms to stomach poisons is due to the fact that insoluble poisons are ingested by them to only a limited extent.

CAKEBREAD (E. J. N.). **The Development of Nitro-phenols in the Control of Red-spider.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 399–407. Heverlee [? 1947].

The author reviews the results of investigations and field trials made in England in 1934–38, which showed that DNC (3, 5-dinitro-o-cresol [numbered with CH_3 as 1]) improved the efficiency of petroleum oils against the winter eggs of the red spider [*Paratetranychus pilosus*, C. & F.] on fruit trees, and describes further investigations to explain the varying effects observed on both eggs and plants when DNC sprays were used on a commercial scale. It was found that DNC readily formed salts with metallic compounds and that many of these were injurious to plant growth and had less ovicidal effect. The percentages of the DNC content deposited on sprayed surfaces by sprays prepared from the standard concentrated emulsion containing 2 per cent. DNC in petroleum oil varied from 70 when the pH value of the spray was 3 to 20 when it was 8, and examination of the dispersion of the DNC between the oil and water phases of the concentrated emulsion showed that the percentage in the oil phase varied from 99·9 at pH 3 to 82 at pH 6 and 18 at pH 8. It appears therefore that an emulsion that has an acid reaction and will produce an acid spray liquid, even with fairly alkaline water, is required [*cf. R.A.E.*, A **36** 274]. Tests to ascertain the degree of acidity needed, carried out with diluted emulsions containing 0·1 per cent. DNC and 5 per cent. light spindle oil, showed that the percentage mortality of the eggs decreased from 99 at pH 3 to 97 at pH 5, 92 at pH 6 and 84 at pH 7, indicating that a pH value of 3–5 is necessary for the concentrated emulsion, the lower value being preferred in case very alkaline water is used for diluting it. In England, commercial emulsions of this type have used for three seasons and have given far more consistent results against the eggs of Aphids and Psyllids and much better control of those of the mite than the ordinary emulsion. In heavy infestations, it is impossible to obtain contact between the DNC and all the eggs, so that kill is incomplete, and large populations may develop later in the season if even a few of the winter eggs hatch.

The introduction of DNCP (dinitro-o-cyclohexylphenol) has simplified the control of Tetranychid mites in summer. In field tests on hops in 1940,

a dust of 1 per cent. DNCP in an acid carrier, such as oak-wood flour, gave consistently good kills of mites [*Tetranychus telarius*, L.] (95 per cent. of the adults and 80 per cent. of the eggs), with no phytocidal reaction [*cf.* **34** 100]. When kaolin, bentonite, talc and kieselguhr were used as carriers, they formed salts with the DNCP and these frequently reduced acaricidal action and increased the phytocidal effect. Moreover, even the acid dust injured tomatoes and grape-vines grown under glass, though it gave excellent control of *T. telarius* on them, and tests were therefore carried out with the dicyclohexylamine salt of DNCP [*cf.* **29** 560], which gave good control of the mite and caused little injury to the plants. This salt did not kill the Anthocorid bug [*Anthocoris nemorum*, L.], a fairly common predator on *P. pilosus* on fruit trees in England, and investigations on its use against Tetranychids on a wide range of plants were therefore begun. Commercial preparations having the necessary acid reactions were used.

A liquid concentrate containing 2 per cent. of the salt as a fine suspension with suitable wetting agents, diluted with water (1 : 99) and applied to heavily infested fruit trees, killed 96 per cent. of the adults of *P. pilosus* and 79 per cent. of the eggs, and no further infestation developed, probably because predators, notably the Anthocorid, were active. Such biological control after spraying with this compound is now an important factor in the summer control of *P. pilosus* in England. No damage to foliage occurred except when the spray was applied soon after lime-sulphur or petroleum oils, and it is concluded that it should not be applied within 14 days of these materials. A 1 per cent. dust and the spray at lower concentrations gave equally good results in tests against *T. telarius* on all the varieties of hops grown commercially in England. The dust gave maximum control when used at 100 lb. or more per acre and caused no damage to the plants and no deterioration in quality after the late applications (when the hop cones were well developed) that are often necessary against the mite. The spray concentrate gave 95 per cent. control of light infestations when diluted with water to 1 : 199 and of heavy ones when diluted to 1 : 149 [*cf.* **34** 100]. On tomatos under glass, the dust gave an average control of *T. telarius* of 70 per cent. and the spray concentrate diluted to 1 : 199, the highest concentration that can be used under all conditions, gave 98 per cent. kill of adults and 80 per cent. of eggs after five days and caused no damage to the plants. The population began to increase again after about a month, and observations over a period showed that spraying should be repeated at intervals of six weeks. Both the dust and the spray gave more than 90 per cent. control on carnations under glass, but the dust is preferable as the foliage is not easily wetted by a spray. The flowers of some varieties were stained slightly by both dust and spray, and it is recommended that they should be cut before the plants are treated. The spray scorched the leaves, young shoots and fruits of grape-vines, and the dust caused some scorching of young shoots under conditions of extreme heat ; the dust is being used on vines in England, but further research on it is necessary. The treatments appear to be unsuitable for cucumbers, as although the plants are not damaged, the kill of mites is very poor on them. Peaches under glass, violets, roses and several other flower crops were all successfully treated with no damage to the plants, although it is advisable to cut the blooms of all flower crops before treatment in order to prevent marking.

Blattny (C.). **Notes sur l'application des produits à base d'ortho-dinitrocresol contre les oeufs d'hiver du** *Paratetranychus pilosus*.—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 408–409. Heverlee [? 1947].

In Czechoslovakia, products containing DNC (dinitro-o-cresol) have been used since 1940 as dormant sprays for control of the winter eggs of *Paratetranychus pilosus*, C. & F., on fruit trees, but with variable results. In the

laboratory, 1·5 per cent. dilutions of a product containing 25 per cent. DNC were more than 90 per cent. effective, whereas in the field the effectiveness of 2 per cent. dilutions varied from over 90 down to 35 per cent.

The following are among the conclusions drawn from comparative tests. The trees should be sprayed, preferably just before the eggs hatch, with 2–3 per cent. dilutions of products containing at least 25 per cent. DNC, and the spray should be applied copiously so that all the eggs are completely wetted. The effectiveness of the treatment is increased by high temperature and humidity, but not by high humidity if the temperature is low. The control given varies with the wetting agent employed and the degree of penetration of the DNC into the egg. On plum, supplementary treatment with materials containing sulphur should be carried out before and after blossoming.

A severe outbreak of *P. pilosus* that occurred in 1938–43, on plum only, was practically eliminated by an intensive control campaign in nurseries and orchards, but the mite was increasing again in 1946, following hot, dry years.

FULLER (G.). **Selenium Compounds in Greenhouse Pest Control.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 411–415. Heverlee [? 1947].

Investigations in Ohio have shown that soil treatment with sodium selenate offers distinct practical advantages for the control of some greenhouse pests, particularly red spider [*Tetranychus*] and Aphids, which are poisoned by the selenium in the plants [*cf. R.A.E.*, A **29** 275 ; **30** 273, etc.]. In tests with aqueous solutions against *Tetranychus* and thrips on the Princeton variety of chrysanthemum, excellent mite control was obtained, but a higher rate of application than is usually recommended was required. Sodium selenate at less than 0·5 gm. per sq. ft. gave only partial control, but at 0·5 gm. and higher it almost completely eliminated the mite ; a population count made two months after treatment showed an average of 2 living examples per leaf on treated plants as compared with 70 on the controls. P-40 (a granular superphosphate containing 2 per cent. sodium selenate) gave inadequate control at the recommended rate of 3 lb. per 100 sq. ft., but was satisfactory at 6 lb. ; it appeared to be about as effective as equivalent dosages of sodium selenate applied in solution. Thrips were not completely controlled in any of the tests, but damage by them was materially reduced on all plants that received sodium selenate at 0·5 gm. or more per sq. ft. of soil. There was little evidence of plant injury due to selenium, even at dosages of more than 1 gm. sodium selenate per sq. ft. Plant analyses showed that the selenium content of the foliage was relatively low, either because the Princeton variety has a low capacity for accumulating selenium or because a soil factor prevented its absorption.

In an experiment against greenhouse Aphids on the Snow variety of chrysanthemum, selenium salts were applied as dry top dressings, diluted with large amounts of finely divided agricultural gypsum (calcium sulphate) or limestone (calcium carbonate), which were applied at about 9 and 5 lb. per 100 sq. ft., respectively. A dosage of 0·2 gm. sodium selenate per sq. ft. or an equivalent amount of some other selenates, gave excellent Aphid control when applied with limestone, but some injury to the lower leaves of the plants occurred ; with gypsum, however, only partial control was obtained at this rate. The best treatment, on the basis of adequate Aphid control combined with minimum toxicity to the plants, was 0·4 gm. selenate per sq. ft., applied in gypsum ; plants that received it were free from Aphids and flowered normally, while untreated plants bore over 600 Aphids per stem tip and failed to produce flowers. Plant analysis indicated that the gypsum carrier reduced the absorption of selenium by the plant by nearly 50 per cent. and also appeared to cause some reduction in the toxic effect of the selenium absorbed, probably owing

to the available sulphur content of the gypsum. It is suggested that gypsum, or some other source of available sulphur, might therefore be used as a top-dressing to reduce plant damage resulting from an accidental overdose of selenium or to reduce the amount of selenium absorbed by vegetables subsequently grown in treated soil.

The time taken by plants to absorb selenium was studied on chrysanthemums. Plants of two varieties were set on 26th June, and sodium selenate was applied, as an aqueous solution, at the rate of 0·25 gm. per sq. ft. of soil, on 21st July. Analysis showed that the selenium content of the entire tops of the plants of the two varieties in parts per million increased from 149 and 157 on 10th August to 325 and 428 on 10th September and was still 287 and 330 on 9th October ; since other experiments have shown that a selenium content of 150 p.p.m. is adequate for the control of *Tetranychus* and Aphids, an effective quantity of selenium was thus absorbed within three weeks of the date of application and maintained for the duration of the experiment.

In tests to ascertain the amount of selenium absorbed by a vegetable crop grown in soil treated for a previous florist crop, it was found that onion sets and lettuce absorbed 3·44 and 0·24 p.p.m. (fresh weight), respectively, during their first two months of growth in a soil bed watered by subirrigation. Calculations based on these figures and on published reports on the maximum safe rate of selenium intake by man show that a daily consumption of as much as 9 lb. of the lettuce or 0·6 lb. of the onions would not provide enough selenium to endanger health. In a further experiment, however, in which leaf and head lettuces were grown in soil that had been used for six months to grow chrysanthemums in pots after having been treated more than a year previously with sodium selenate at the rate of 0·5 gm. per sq. ft. of soil, the selenium content of the lettuces at maturity was 4·2 p.p.m., but a daily consumption of 0·5 lb. of the lettuce would still not exceed the limits of safety.

FARRAR (M. D.). **The Use of Sodium Selenate on Greenhouse Bench Soil for the Control of Plant Pests.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 416–417. Heverlee [? 1947].

The results are summarised of tests in Illinois on the control of greenhouse pests by soil treatment with sodium selenate in solutions [*cf.* preceding abstract]. When an entire greenhouse of carnations was treated with 0·25 gm. sodium selenate per sq. ft. of soil, applied before the benches were planted, red spider [*Tetranychus*] did not develop on standard varieties to a point at which spraying was required, but spraying became necessary on some seedling varieties that grew slowly. When carnations were planted in July in benches treated at four rates, further treatment was required in February by those that received 0·125 or 1 gm. selenate per sq. ft. and in March by those receiving 0·25 or 0·5 gm. per sq. ft., while the controls required treatment by December. Growth was normal in plots treated at the three lower rates, but the highest resulted in poor plant growth and considerable damage by the mite. When soil bearing seven varieties of carnation was treated in October, about 60 days after planting, with 0·25 and 0·5 gm. selenate per sq. ft., the mite was checked until February, whereas the controls became heavily infested by December ; these were treated with 0·25 gm. in January but never fully recovered from the injury. All treatments were losing their effectiveness by 1st May. The varieties responded differently to treatment, the more vigorous plants showing the greatest response. In a further test in which the soil was treated with 0·25 gm. per sq. ft. before the carnations were planted, satisfactory control of the mite continued until the end of February, when some form of control became necessary ; the more vigorous varieties suffered less mite injury than

the weaker ones. Some benches showed signs of apparent overdosage in places, indicating an uneven distribution of the selenate.

Sodium selenate at 0·5 gm. per sq. ft. applied to chrysanthemums soon after planting controlled *Tetranychus*, mealybugs and thrips, but gave only fair control of Aphids and the chrysanthemum midge [*Diarthronomyia chrysanthemi*, Ahlberg]. On gladiolus, 0·25 gm. gave satisfactory control of the gladiolus thrips [*Taeniothrips simplex*, Morison], but 0·5 and 1 gm. damaged the crop. Growth was slow, and the plants sustained severe thrips injury. On snapdragon [*Antirrhinum*], 0·125 gm. caused no plant injury, but some varieties were injured by 0·25 gm., most by 0·5 gm. and all by 1 gm. Treatment also caused severe injury to *Schizanthus*.

LOUNSKY (J.). **Perspective nouvelle dans la désinsectisation du sol, spécialement du point de vue des quarantaines phytosanitaires. (Communication préliminaire.)**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 418–422, 1 fig. Heverlee [? 1947].

Tests were carried out in Belgium to ascertain whether treatment with DDT could be applied to the soil balls round the roots of ornamental plants for export to ensure freedom from infestation by insects on arrival at the destination. Spherical wire baskets about 8 ins. in diameter, were filled with azalea mould and immersed for 15 or 30 minutes in an emulsified solution containing 0·05 per cent. DDT. and buried in a greenhouse. They were subsequently watered in the same manner as the azaleas growing in the house. Samples of soil were taken from the centres of the baskets immediately after treatment and 15, 30, 45 and 60 days later and placed in contact with Tipulid larvae in petri dishes. The larvae showed symptoms of poisoning after 2, 4, 4, 5 and 6 days and were all dead after 9, 10, 12, 21 and 18 days, respectively, while mortality in the controls did not exceed 20 per cent. The period of immersion did not affect toxicity, but the DDT acted more slowly in dry than in damp soil. Azalea plants were not injured by dipping for 15, 30, 60 or 120 minutes in emulsified solutions containing 0·05, 0·1 or 0·2 per cent. DDT.

It is concluded that the treatment would give control of pests hatching in the soil balls for a period of at least two months.

CALLENS (J. Y.). **Quelques résultats obtenus dans la lutte contre les insectes parasites des plantes cultivées au moyen du D.D.T.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 423–428. Heverlee [? 1947].

Examples are given of the successful results obtained in Belgium with DDT, used as a 5 per cent. dust or a 0·05 per cent. spray suspension against various pests. When a spray was applied to a field of flax heavily infested by the flax flea-beetle [*Aphthona euphorbiae*, Schr.], only a few examples were found the next day, all showing typical symptoms of DDT poisoning. The dust had some effect against larvae of *Autographa* (*Plusia*) *gamma*, L., which appear on flax late in the season, but as many of the larvae were parasitised, the results could not be accurately determined. In work against *Leptinotarsa decemlineata*, Say, on potato in all parts of Belgium and at widely different temperatures and humidities, both dust and spray gave good control, particularly the spray, and the effects persisted for 3–4 weeks. In extreme heat, complete mortality of the larvae was obtained after a few hours, whereas in cold and damp weather up to three days was required.

A single application of a DDT spray gave complete control of the pea and bean weevil [*Sitona lineatus*, L.], on heavily infested peas. In previous years, beans grown after peas were severely infested as soon as they appeared above ground, but in 1946, when the beans were sprayed with the DDT suspension

as soon as they appeared, weevil damage was prevented and an adequate yield obtained. Either dusting or spraying gave complete control of flea-beetles on crucifers, cabbage seedlings being protected by a single application, and a DDT spray immediately checked damage to cabbage by *Plutella maculipennis*, Curt., and to the leaves of strawberry by *Phyllobius oblongus*, L. Fruit trees attacked by cockchafers have been successfully treated with a 0·1 per cent. DDT spray, and excellent results were obtained in 1946 with DDT dusts against thrips on vines under glass.

DDT has also been tested for the protection of stored food-stuffs. *Calandra* was completely eliminated from a granary, and bakeries have been freed from cockroaches by dusting with DDT. Ants, woodlice and *Lepisma saccharina*, L., in houses have also been destroyed.

Emulsified solutions have been used on ornamental plants, on which marking is undesirable, and have given excellent results against ants, woodlice, Coccids, Aleurodids, Aphids, thrips and the azalea moth [*Gracilaria azaleella*, Brants].

Beran (F.). **The Effect of various Fumigants on San José Scale** (*Aspidiotus perniciosus* **Comst.**).—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 429–432, 5 refs. Heverlee [? 1947].

In laboratory experiments carried out in Austria to ascertain whether they could satisfactorily replace hydrocyanic acid gas for the fumigation of dormant nursery stock against *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., ethylene oxide, methyl bromide and phosphine were tested at rates of 1·5, 2·5 and 0·2 oz. per 100 cu. ft., respectively, and required exposure periods of 2, 1 and 15 hours to give complete mortality, whereas hydrocyanic acid gas at 0·25, 0·5 and 1·4 oz. gave complete mortality in 4·2, 5 and 48 minutes. The rates of mortality for shorter periods of exposure and in the controls are given in a table. Since a short fumigation time is desirable in practice and either the concentration of fumigant or the exposure period would need to be greater than under the exact conditions of the laboratory, none of the fumigants tested can be regarded as a satisfactory substitute for hydrocyanic acid gas.

Tilemans (E.). **Essai de standardisation des expériences biologiques.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 433–440, 3 figs., 1 graph. Heverlee [? 1947].

The author reviews published methods of carrying out biological assays of stomach and contact insecticides [*cf. R.A.E.*, A **18** 311, 433, 481 ; **21** 385 ; **23** 81 ; **28** 137] and suggests that, in view of their diversity, the adoption of standard methods by international agreement is highly desirable.

Ayoutantis (A.). **Essais de lutte contre le** *Dacus* **par le D.D.T.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 443–447. Heverlee [? 1947].

Experiments were carried out in July–August 1946 in three districts of Greece on the control of *Dacus oleae*, Gmel., on olive, by DDT aerosols dispersed from aeroplanes applying a 20 per cent. solution of DDT in Velsicol at a rate equivalent to about 1 mg. per sq. ft. The effectiveness of the treatment was estimated by comparing the numbers of flies caught in bait-traps on experimental trees and on controls. In one district in the south of Corfu, no reduction was evident for two days after treatment, but the numbers of flies were reduced by about 50 per cent. for the next ten days, after which observations were discontinued. In the north of the island, the population was reduced by 76 per cent. 9–13 days after treatment, and then increased ; after about a

month it was rather higher than on the control trees. In the province of Locris, the population was reduced to 16 per cent. of the controls immediately after treatment and to 11–64 per cent. at different periods during about six weeks. These results are considered promising, and it is thought that, where the type of country permits the use of aeroplanes, this method of control may prove more efficient and economical than the use of bait-sprays [*cf. R.A.E.*, A **28** 585].

PESTEL (E.). **L'utilisation des huiles blanches en phytopharmacie.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 449–454. Heverlee [? 1947].

The author reviews the characteristics of white oils and the ways in which they are used in winter and summer sprays against pests of fruit trees. In 1943 and subsequently, particularly in the spring of 1946, excellent control of *Anthonomus pomorum*, L., on apple was obtained in various parts of France with 1 per cent. white oil containing DDT or polychlorcyclohexane sulphide, as the oil prolonged the effectiveness of the organic insecticides from bud-burst until blossoming and obviated the necessity for a second pre-blossom treatment.

In the discussion, P. Frezal stated that two applications of 3 per cent. winter white oil are essential for the satisfactory control of heavy infestations of the San José scale [*Quadraspidiotus perniciosus*, Comst.] in Algeria and also that a spray containing 3–4 lb. copper sulphate in 100 gals. white oil emulsion is commonly used there for the control of Coccids and the sooty mould associated with them.

MENDIZABAL (M.). **Expériences sur l'efficacité insecticide du Gammexane (666) contre les pucerons.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 455–460. Heverlee [? 1947].

BENLLOCH (M.). **Essais de laboratoire sur l'action par contact des insecticides organiques chlorés (D.D.T et 666).**—*Op. cit.* pp. 469–478.

These papers contain accounts of experiments in Spain already noticed [*R.A.E.*, A **36** 199] on the use of γ benzene hexachloride in sprays against Aphids and on the contact action of DDT and benzene hexachloride on *Leptinotarsa decemlineata*, Say.

MENDIZABAL (M.). **Expériences pour déterminer l'efficacité des insecticides organiques chlorés (D.D.T. et 666) contre certains Coléoptères et Lépidoptères nuisibles à la luzerne.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 461–467. Heverlee [? 1947].

The author recapitulates experiments by A. Alfaro showing the effectiveness of DDT and benzene hexachloride against Coleoptera on lucerne in Spain [*cf. R.A.E.*, A **36** 203] and states that in a further experiment, a spray prepared from a product containing 5 per cent. DDT, diluted to 1 per cent., gave complete mortality of *Colaspidema atrum*, Ol., on lucerne in various parts of the Province of Alicante in 18–20 hours. In Saragossa, a similar spray gave 90 per cent. mortality of nearly full-fed larvae of *C. atrum* in 48 hours and complete mortality in 72 hours when applied in clear, cool weather.

Experiments against *Loxostege* (*Phlyctaenodes*) *sticticalis*, L., and *Nothris lotellus*, Const., on lucerne in Valencia [*cf.* **20** 250] were carried out in 1945 with two products containing 5 per cent. DDT and one containing 15 per cent. benzene hexachloride, and the results were estimated by counts, made every 2–3 days, of the moths caught on treated and untreated plots by poison baits

of 0·25 per cent. sodium arsenate in 10 per cent. molasses solution, without distinguishing the two species. The moths appeared on 31st July, and severe damage was caused in the first half of August. The catches showed that, as compared with 100 in the controls, the numbers of moths taken following a single spray on 31st July were 48 for the benzene hexachloride product and 43·7 and 25·6 for the two DDT products, respectively, all diluted to 1 per cent. When these products were diluted to 1, 1·5 and 2 per cent. and applied three times, on 31st July and 1st and 26th September, the figures were 21·7, 22·1 and 22 for the benzene hexachloride product, 27, 21 and 26·8 for the first DDT product and 63·4, 54·9 and 51·3 for the second ; the best result was given by three applications of the first DDT product as a dust, for which the figure was 17·3.

It is concluded that the moths can be successfully controlled with three applications of sprays of DDT or benzene hexachloride, the first as soon as the adults appear and the other two after successive cuttings, although in normal years the third application may be omitted.

BREDO (H. J.). **Le " Gammexane " dans la lutte contre les sauterelles.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1947* pp. 485–491. Heverlee [? 1947].

There was a severe outbreak of *Nomadacris septemfasciata*, Serv., in the Lake Rukwa region of Tanganyika Territory in 1945–46, and the supplies of sodium arsenite for use in poison baits [*cf. R.A.E.*, A **35** 163] ran short. Experiments were therefore carried out with a preparation consisting of 20 per cent. benzene hexachloride in diatomaceous earth ; the γ isomer content of the benzene hexachloride was 10–12 per cent. Baits consisting of a 1 : 3 mixture of the preparation with cassava flour killed 75 per cent. of the hoppers in the first three instars in 24 hours and 98 per cent. in 48 hours. The preparation was then applied as a fine cloud to grass at an unstated rate and gave 65, 75 and 80 per cent. mortality in 24, 48 and 72 hours, respectively ; when it was applied at half the rate, the corresponding percentages were 50, 60 and 65.

Excellent results were obtained with aqueous suspensions. The dry preparation was placed in an empty petrol tin, water was added, and a suspension was formed when a brush made of a bundle of grass or fibres was plunged into it ; the liquid could be thrown from the brush for a considerable distance and over a wide area. When bands of hoppers were treated in this way, the suspension gave 95 per cent. mortality of individuals in the first three instars in 6 hours at a concentration of 5 per cent. actual benzene hexachloride, and 80, 90 and 99 per cent. of hoppers in the second–fourth instars in 6, 48 and 72 hours at 2 per cent. and 70, 80 and 92 per cent. in 6, 24 and 48 hours at 1 per cent., respectively ; when applied to adults, a 2 per cent. suspension killed 90 per cent. in 48 hours immediately after the final moult, and a 3 per cent. suspension killed 60 per cent. in the same time three days after it. The method gave good results against dense bands of hoppers in short, medium and high grass (*Cynodon*, *Echinochloa* and *Pennisetum*) and is best adapted for use on vegetation. Three days after large bands were treated, very few living hoppers could be found in the treated areas. The 60 per cent. mortality of adults obtained was considered adequate, and it was thought that, owing to their great mobility, about one-third of them had not come in contact with the insecticide. A second treatment should therefore be applied after three days when it is desired to control adults in phase *transiens* or *solitaria*, while the use of aeroplanes is advisable against the rapidly moving locusts in phase *gregaria*.

Advantages of benzene hexachloride for use in a locust campaign include its low toxicity to man and domestic animals (a demonstrator himself swallowed

a spoonful of the material with slight temporary effects only) and, if it is applied in suspension, a saving of the food materials used in baits, and ease of transport, since it can be mixed with water at the site.

LEFÈVRE (P. C.). **Poudres de derris, de pyrèthre et D.D.T. dans la lutte contre *Antestia* prox. *lineaticollis* Stål.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 493–501, 4 refs. Heverlee [? 1947].

An account is given of laboratory experiments in the Belgian Congo to compare the effectiveness of dusts of DDT, pyrethrum and derris for the control of a species of *Antestia* resembling *A. lineaticollis*, Stål, which is an important pest of arabica coffee [*cf. R.A.E.*, A **34** 280, etc.]. The properties of the three insecticides are reviewed and it is pointed out that pyrethrum and derris have the advantage of being readily obtainable locally. In the tests, adults of *Antestia* were dusted in gauze sleeves and transferred to petri dishes, where they were given fresh coffee berries. Counts of knockdown and mortality were made, and the percentage control was calculated by Abbott's formula [**13** 331]. In the first test, a pyrethrum powder containing 0·8 per cent. pyrethrins gave complete knockdown in 15 minutes and complete mortality in 20 hours, while a dust containing 7·5 per cent. DDT gave only 9 per cent. knockdown and not quite 50 per cent. control in the same periods, 46 hours being required for complete mortality. In a second test, in which the pyrethrum powder was diluted with wood ash to contain 0·19 per cent. pyrethrins, the DDT dust gave 97·77 and the pyrethrum dust 86·66 per cent. control in 46 hours, but there was little difference in effectiveness during the first 21 hours. Derris dusts containing 1·84, 5·74 and 11·06 per cent. rotenone gave 37·9, 37·6 and 64·9 per cent. control, respectively, in 120 hours.

It is concluded that pyrethrum is more effective than DDT against *Antestia* and that derris is of little value. It was pointed out in the subsequent discussion (p. 502) that DDT has given good results in the field against *Antestia lineaticollis* on coffee in the French Cameroons [**35** 305].

VRYDAGH (J. M.). **Le traitement des bois contre les insectes xylophages.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 503–508. Heverlee [? 1947].

This is a review of methods of protecting cut timber from attack by insects, with special reference to the Belgian Congo, where limba (*Terminalia superba*) is seriously damaged by *Lyctus brunneus*, Steph. [*cf. R.A.E.*, A **36** 1] and termites and Platypodids also constitute a problem.

WESTENBERG (L.). **Gebruikelijke eischen gesteld aan bestrijdingsmiddelen in Nederland.** [Standards to which Insecticides and Fungicides should conform in Holland.]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 541–548. Heverlee [? 1947].

This is a list of insecticides and fungicides used on plants in Holland, with notes on their chemical composition and the standards to which they should conform.

BESEMER (A. F. H.). **Testmethoden voor het onderzoek van de eidoodende werking van winterbestrijdingsmiddelen.** [Methods of testing the ovicidal Effect of Winter Sprays.]—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 557–571, 4 figs., 28 refs. Heverlee [? 1947].

The need for a reliable method for laboratory tests of the ovicidal value of materials used as winter sprays against pests of fruit trees has become increasingly evident in recent years, owing to the length of time required to evaluate

the results of field tests with numerous different spray preparations. The author reviews the more important laboratory methods and describes a technique already noticed [*R.A.E.*, A **36** 111–112] involving the microscopic examination of the contents of treated eggs, by which results can be obtained in a comparatively short time. It is emphasised that a particular preparation does not necessarily give the same degree of control of eggs of different species of insects. The same is true of different stages of a given species; a recent instance is cited in which a benzene hexachloride dust containing 0·007 per cent. γ isomer gave complete mortality of adults of the oak flea-beetle [*Haltica quercetorum*, Foudr.], whereas a γ isomer content of 0·125 per cent. was required to give complete mortality of the larvae.

Raucourt (M.) & Bégué (H.). **Travaux français récents sur les produits phytopharmaceutiques.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 585–600, 25 refs. Heverlee [? 1947].

The authors review the literature on work carried out in France since 1940 on insecticides and fungicides to replace scarce materials. The insecticides include arsenicals, phenothiazine, dinitro-o-cyclohexylphenol, DDT and benzene hexachloride, and notes are given on the dosages at which they have proved effective against *Leptinotarsa decemlineata*, Say, the usual test insect, on the control of some other pests by benzene hexachloride [*cf. R.A.E.*, A **33** 331; **35** 421] and of weevils on fruit trees by DDT, and on the possible danger of arsenicals to cattle and game [*cf.* **34** 83].

The control of *Quadraspidiotus perniciosus*, Comst., on fruit trees is also briefly discussed; tests of vegetable oils against it indicated that ground-nut oil might be of value [**35** 291], and it was subsequently found that a 3 per cent. emulsion of ground-nut oil containing 2 per cent. dinitro-o-cyclohexylphenol applied in winter gave 99·8 per cent. mortality. In laboratory tests of methyl bromide as a fumigant against this Coccid, the necessary concentration was high, the product of concentration (in gm. per cu. m.) x time (in hours) being 100.

Gallay (R.). **État actuel de la lutte antiparasitaire en Suisse.**—*Rep. 1st int. Congr. Plant Prot. Heverlee 1946* pp. 601–624, 2 figs., 2 graphs. Heverlee [? 1947].

Some of the information in this review of work on recently developed methods of pest control in Switzerland has already been noticed [*R.A.E.*, A **35** 145]. Emulsified solutions of DDT have proved more effective than suspensions against *Cydia* (*Carpocapsa*) *pomonella*, L., on apple, but destroyed the natural enemies of *Paratetranychus pilosus*, C. & F., and *Eriosoma lanigerum*, Hsm., and caused some scorching. Tests in 1946 supported the conclusions of workers in the United States that the inclusion of 0·4 per cent. brown sugar in lead-arsenate sprays increases their efficiency against *C. pomonella* [*cf* **29** 129; **31** 20]. Suspensions of DDT with a wetting agent gave up to 80 per cent. control of *Hoplocampa minuta*, Christ, and *H. flava*, L., on plum in 1944 and 1945, but were relatively ineffective in 1946, when benzene hexachloride was distinctly superior. *Anthonomus pomorum*, L., on apple, can be controlled with sprays of dinitro-o-cresol or DDT, applied just before bud-burst [*cf.* **35** 70], and benzene hexachloride also shows promise against it.

Tests in 1945 and 1946 showed that emulsified solutions of DDT were more effective than suspensions against *Clysiana* (*Clysia*) *ambiguella*, Hb., and *Polychrosis botrana*, Schiff, on vines, but benzene hexachloride was useless. The danger of damage by *Phylloxera vitifoliae*, Fitch [*cf.* **33** 124] has been almost eliminated, as restocking with vines grafted on resistant stocks has

been completed in all areas except a few in German Switzerland and the upper Valais. Other vines are sprayed during the dormant season with tar distillate (emulsified carbolineum [*cf.* **35** 70]), which destroys the winter eggs.

The author quotes from a report in which it is stated that although *Leptinotarsa decemlineata*, Say, has spread eastwards right across Switzerland [**35** 288], it does not occur in a few valleys in the Alpine region or in certain parts of the cantons of Grisons and the Ticino. The control measures employed, which include the hand-collection of adults and eggs in the less heavily infested areas and the application of arsenical sprays and suspensions of DDT, have prevented serious damage to potato.

Lepigre (A. L.). **Technique de la désinsectisation.**—270 pp., 31 figs., 21 pp. refs. Algiers, the Author, 1947.

This handbook is concerned primarily with the control of insect pests by fumigation, but notes on the importance of the principal categories of medical and veterinary pests and other control measures available against them are given in preliminary chapters. A longer chapter contains instructions for treatments against pests that attack man and domestic animals or are found in buildings or infesting stored products, and a short account of the ways in which fumigants can be used against agricultural pests. Others include information on heat treatments and light-traps; the properties and uses of DDT, benzene hexachloride, rotenone, pyrethrins and various fumigants; warning gases and their use in fumigation; the ways in which fumigation technique and dosage rates are influenced by the physical properties of gases, temperature, humidity, the nature of the premises in which the treatment is to be carried out and the distribution of the commodities within them; the types of containers suitable for fumigants and other insecticides and for products that have been fumigated; and the equipment needed. The book also contains lists of materials and equipment for mobile fumigation units, notes on the detection of toxic gases, detailed instructions for the treatment of cases of poisoning by fumigants, and a chapter on the French legislation relating to certain fumigants.

Frear (D. E. H.). **A Catalogue of Insecticides and Fungicides. Volume I. Chemical Insecticides.**—*Ann. cryptog. phytopath.* **7** xi+203 pp., frontis., 14½ pp. refs. Waltham, Mass., Chronica Botanica Co.; London, Wm. Dawson & Sons, Ltd., 1947. Price $6.50 or 39*s*.

This is the first volume of a catalogue designed to present data concerning some 10,000 compounds tested against insects and fungi before 1944, obtained from published and unpublished reports. The greater part of it consists of a list of chemical insecticides, in which the name and, in most cases, the chemical formula of each is followed by the insects against which it has been tested and, where possible, the concentration at which it was employed, an indication of its toxicity, and bibliographical references (including references to patents). The compounds are arranged according to a numerical coding system explained in the introduction; basic code numbers enable the number for any particular compound to be worked out from its chemical composition. There are also the bibliography and a list of patent numbers arranged by countries.

Hicks (C. S.) & Sinclair (D. A.). **Toxicities of the optical Isomers of Nicotine and Nornicotine.**—*Aust. J. exp. Biol. med. Sci.* **25** pt. 1 pp. 83–86, 2 figs., 7 refs. Adelaide, 1947.

Experiments on the relative toxicity of the optical isomers of nicotine and nornicotine to rats and guineapigs showed that d-nornicotine was three times

as toxic as l-nornicotine and d- and l-nicotine, which were equal. Tests carried out to examine the comparative insecticidal powers of d-nornicotine and l-nicotine showed that larvae of the salt-water mosquito, *Aëdes concolor*, Taylor, which were chosen as the test insects because Aphids were not available, possessed remarkable resistance to both. Dead and living larvae were too difficult to distinguish for accurate counts to be made, but general observations indicated that the toxicity of nornicotine was of the same order as that of nicotine. The larvae were kept in sea water treated with neutral hydrochlorides of the alkaloids and examined next day. Even in alkaloid concentrations of 1 : 250, some still showed tremlous movement, and in 1 : 10,000 there were no noticeable effects. When larvae that had been in the 1 : 250 solutions for 22 hours and others that had been in 1 : 500 solutions for two days were transferred to fresh sea water, about 24 per cent. in each beaker had fully recovered on the following day.

Dethier (V. G.). **Chemical Insect Attractants and Repellents.**—9¼×6 ins., xv+289 pp., 69 figs., many refs. Philadelphia, Pa., Blakiston Co., 1947. Price $5.

This book is designed to elucidate the basic principles underlying the action of substances that attract or repel insects and is a compilation of information on the chemical, physical, physiological and botanical factors involved together with interpretations and evaluations of existing work in the light of these principles. Since specific chemoreception is regarded as a unit of behaviour on which practical measures might be based, the chemical aspect is stressed, but an introductory chapter includes notes on other types of stimuli. Following a general account of the sources and influence on insect behaviour of the various kinds of chemical attractants that occur in nature, three chapters are devoted to the chemistry of essential oils, resins and related substances produced in plants and serving to attract phytophagous insects to their food-plants and work on the reactions of insects to them ; fermentation products and work on their use as attractants for fruit and timber pests ; and decomposition products of fats and proteins that attract necrophagous, sarcophagous and blood-sucking insects and insects that feed on fungi and algae. A further chapter contains information on repellents, including naturally occurring and synthetic ones, and the ways in which they are utilised in insect control. Other subjects dealt with are apparatus and methods for measuring the responses of insects to odours, the chemical basis of taste and olfaction, the uses made of traps and baits in insect control and the factors influencing their effectiveness, and the mechanisms involved in the feeding preferences of phytophagous insects and the evolution of feeding habits.

Chiu (Shin-Foon), Lin (Sping) & Hu (Ching-Yung). **Toxicity Studies of insecticidal Plants in south-western China.** [*In Chinese.*]—[i+] 54 [+2] pp., 7 figs., 4 graphs, 6 pp. refs. Canton, Coll. Agric., Nat. Sun Yat-Sen Univ., 1946. (With a Summary in English.)

The following is based on the authors' summary of work in 1940–43 on the insecticidal properties of plants collected in south-western China. The methods and equipment used are described, and the literature is reviewed. In all, 25 plants were tested against 34 insects, and the insecticidal properties of *Millettia pachycarpa*, *Tripterygium forrestii* and *Rhododendron molle* were studied in detail. In laboratory spraying experiments, a suspension of the finely-ground seeds of *M. pachycarpa*, which contain rotenone and rotenoids [*R.A.E.*, A **30** 528], was effective against Aphids, the cotton stainer, *Dysdercus cingulatus*, F.

(*megalopygus*, Bredd.), the bean Pentatomid, *Coptosoma punctatissima*, Mont., the cabbage worm, *Pieris rapae*, L., and other Lepidopterous larvae, the cruciferous leaf-beetle, *Colaphellus bowringi*, Baly, and the black cucurbit beetle, *Aulacophora cattigarensis*, Weise. The roots were slightly toxic, but the stems proved ineffective against *Coptosoma punctatissima*. The pulverised seeds deteriorated when exposed to sunlight or subjected to a temperature of 98°C. [208·4°F.]. The root bark of *Tripterygium forrestii* contains an alkaloid of undetermined structure, and laboratory and field tests showed that it acts as a repellent and a stomach insecticide, but that its contact action is weak. When applied as a dust, it was effective against Chrysomelids and certain Lepidopterous larvae. Upon ingesting the dust, the insects were quickly paralysed, but many recovered after a day or two. Dried and pulverised flowers of *Rhododendron molle*, which contain andromedotoxin and ericolin, acted as both a contact and a stomach insecticide ; the insects became rapidly paralysed and were unable to feed, though they sometimes remained alive for several days. The pulverised flowers were effective against certain Lepidopterous larvae and Pentatomids when applied either as dusts or sprays, but the roots and leaves did not appear to be toxic. Preliminary studies indicated that *Pachyrhizus erosus*, *Derris fordii*, *M. pulchra*, *Pueraria yunnanensis*, *Sophora flavescens*, *Rhamnus crenatus*, *Centella asiatica*, *Buddleia lindleyana* and *Strophanthus divaricatus* also possess insecticidal properties, and of these, *Pachyrhizus erosus* and *D. fordii* represent promising sources of insecticides.

M. pachycarpa appeared to be the most toxic of the plants studied. From determinations of the median lethal dose in mg. per gm. body weight by a modified leaf-sandwich method and comparison with the literature, it was found that its seeds are about as toxic as arsenic pentoxide (M.L.D. 0·024) to fourth-instar larvae of *Bombyx mori*, L. [*cf.* **30** 528] and as commercial calcium arsenate (M.L.D. 0·8) to fifth-instar larvae of *Pieris rapae*. The order of decreasing effectiveness of the four most important plants, based upon their contact action on eight species of insects, was : *M. pachycarpa* (seeds), *Pachyrhizus erosus* (seeds), *Rhododendron molle* (flowers) and *Tripterygium forrestii* (root bark). The powdered root bark of *T. forrestii* appeared to be the most effective as a repellent. All these plants were rather specific in their action ; *M. pachycarpa* did not appear to be toxic to Noctuid larvae. The five plants that showed most promise are widely distributed in southern China and have great possibilities for extensive cultivation as a source of cheap insecticides. The insecticides prepared from them are not phytotoxic and, with the exception of *R. molle*, not very toxic to man. The procedure for commercial manufacture is outlined.

Orlando (A.) & Silberschmidt (K.). **Estudos sôbre a disseminação natural do virus da " clorose infecciosa " das malváceas (Abutilon virus 1. Baur) e a sua relação com o inseto-vetor** *Bemisia tabaci* **(Genn.) (Homoptera-Aleyrodidae).** [Studies on the natural Dissemination of the Virus of the Infectious Chlorosis of Malvaceous Plants and its Relation to the Insect Vector, *B. tabaci*.]—*Arq. Inst. biol.* **17** pp. 1–36, 2 figs., 90 refs. São Paulo, 1946. (With a Summary in English.)

The authors give a detailed account of the experiments that led to the discovery that the infectious chlorosis of malvaceous plants in São Paulo is transmitted by an Aleurodid [*R.A.E.*, A **35** 86] and state that the species concerned has been identified as *Bemisia tabaci*, Gennadius. Further experiments showed that the virus could be transmitted from diseased to healthy plants of *Sida rhombifolia* by a single adult of either sex, and that maximum percentage of transmission was attained with as few as ten insects

per plant. It was also transmitted by the Aleurodid from *S. rhombifolia* to *Abutilon striatum* var. *spurium*.

The literature on the virus is reviewed and its probable geographical limits, affinities to other viruses and possible economic importance are discussed. It is the virus named *Abutilon* virus 1 by Baur and *Marmor abutilon* by Holmes, which has been recorded in wild Malvaceae in various countries, but of which no insect vector was known. The literature on the relation of Aleurodids to other virus diseases is also reviewed.

LEPAGE (H. S.), GIANNOTTI (O.) & ORLANDO (A.). **Toxidês dos constituintes das sementes de *Pachyrrhizus tuberosus* (Lam.) Spreng. var. vermelha, para o afídeo *Brevicoryne brassicae* L. (Homoptera-Aphididae).** [Toxicity of the Constituents of the Seeds of *P. tuberosus*, red Variety, to the Aphid, *B. brassicae*.]—*Arq. Inst. biol.* **17** pp. 249–258, 4 pls., 1 graph, 17 refs. São Paulo, 1946. (With a Summary in English.)

Since the seeds of *Pachyrhizus erosus* have been shown to have insecticidal properties [*cf. R.A.E.*, A **31** 502], tests were carried out in Brazil with those of a red variety of *P. tuberosus*, an annual commonly grown there for its edible tubers. The seeds were pressed to yield an oil or extracted with ether for 24 hours and sprays prepared from the oil or extract were tested in a spray tower on batches of *Brevicoryne brassicae*, L., and compared with a proprietary insecticide (Timboril) containing 5·39 per cent. rotenoids and 0·93 per cent. pyrethrins. The mortality percentages are shown in tables, and it is calculated from them that the concentrations in parts per thousand by volume required to give 50 and (in brackets) 95 per cent. mortality in 48 hours are 0·52 (1·5) for the extract, 1·68 (5) for the expressed oil and 0·22 (0·58) for Timboril.

University of Puerto Rico Agricultural Experiment Station. Annual Report for the Fiscal Year 1943–44.—[4 +] 68 pp., 1 fldg. table. Río Piedras, P.R., 1946.

Various sections in this report deal with work on insects in Porto Rico during 1943–44 [*cf. R.A.E.*, A **34** 31]. Infestation of coffee berries by *Stephanoderes* sp. had not increased in two farms on which it had been first observed in the previous year; it was greatly reduced at the Federal Experiment Station by the thorough collection of all berries. New infestations were discovered on four farms, but all were slight. In the field, this Scolytid has so far been reported only from *Coffea excelsa*, but it also attacked *C. arabica* in the laboratory. Observations on *Inga punctata*, a shade tree introduced for use in coffee plantations, showed that trees on which exudations of gum and exit holes of *Platypus* or *Xyleborus* had been found the year before had recovered, whereas *I. vera* died as a result of similar injury.

Fortnightly observations in five areas during the crop season indicated that infestation of cotton by the pink bollworm [*Platyedra gossypiella*, Saund.] increased gradually from about 2 per cent. at the beginning of January to 93 per cent. in March and April. The types of the wild cotton, *Gossypium hirsutum* var. *punctatum*, with white and brownish lint are important alternative food-plants, and its presence near the coast in the most heavily infested area in the south-west and the fact that fumigation is not carried out at the proper time in cotton ginneries on the south coast are considered to be factors contributing to the increase of the moth.

Work on treatments for rendering wood resistant to *Kalotermes* (*Cryptotermes*) *brevis*, Wlk. [**33** 243] is very briefly reviewed.

STRUBLE (G. R.). **Twig Damage in Sugar Pine caused by the Cone Beetle.**—*J. For.* **45** no. 1 pp. 48–50, 1 fig., 1 ref. Washington, D.C., 1947.

The main features of the bionomics of the Scolytid, *Conophthorus lambertianae*, Hopk., which breeds in the immature cones of sugar pine [*Pinus lambertiana*] in the western United States and may destroy up to 90 per cent. of the seed crop in some localities, were ascertained over 30 years ago [*R.A.E.*, A **3** 667], but the fact that the adults sometimes mine in the twigs, throughout the crowns of sugar pines of varying age and vigour, was not discovered until 1945. In September, examination of faded twig ends in Fresno County, California, showed that each twig had been mined by one of the beetles, which had entered just behind the terminal bud and bored down the centre of the stem for 1–2 ins., the affected twig tips dying shortly afterwards. Observations in October revealed that the destruction of twigs was widespread, the infestation being heaviest in parts of the Yosemite National Park and occurring where cones infested and killed before maturity were lying on the forest floor. Although the young adults normally hibernate within the aborted cones from August until the following spring [*loc. cit.*], it is thought that some, presumably the older members of the broods, emerge from the cones in August and September in certain years and attack the twigs. It seems that they do not hibernate within them, since 90 per cent. of the damaged twigs examined in late autumn had been abandoned. The destruction of the twigs is not particularly injurious to the tree, as the amount of foliage destroyed is relatively small, even on trees having a high percentage of mined twigs.

BUCHANAN (L. L.). **The Japanese Weevil, *Pseudocneorhinus bifasciatus* Roelofs, in America (*P. setosus* of American Records, not Roelofs) (Coleoptera, Curculionidae).**—*Bull. Brooklyn ent. Soc.* **41** no. 4 p. 143. Lancaster, Pa., 1946.

A weevil that was thought to be *Pseudocneorrhinus setosus*, Roel., has been recorded several times from Connecticut [*R.A.E.*, A **12** 421; **20** 644; **22** 597], and specimens from Pennsylvania, from *Forsythia*, barberry [*Berberis*], azalea and other plants in New York, from privets [*Ligustrum*] in New Jersey and from lima bean in Washington, D.C., exist in the collection of the U.S. National Museum. All the American specimens seen by the author, however, including several from Connecticut, proved to be *P. bifasciatus*, Roel., and agreed with a specimen of the latter from Japan, from which country it was originally described. Of the 83 American specimens available, all the 55 from Moorestown, New Jersey, were shown by dissection to be females and the remainder appear on external characters also to be females. It is thus not improbable that the species is parthenogenetic.

REHN (J. A. G.). **The Post-oak Locust (*Dendrotettix quercus*) at Mount Misery, New Jersey, in 1944 (Orthoptera, Acrididae).**—*Ent. News* **57** no. 6 pp. 147–148, 1 ref. Lancaster, Pa., 1946.

An outbreak of *Dendrotettix quercus*, Pack., was reported from the Lebanon State Forest, New Jersey, early in July 1944, and a survey on 26th July showed that it occurred over the same area as the outbreak in 1936 [*R.A.E.*, A **26** 588]. Infestation was sporadic, apparently because chestnut oak and similar species were preferred and scrub oak avoided. Trees and saplings in several places were completely defoliated, but although the Acridids were locally common, they were less numerous than on 1st August 1936. Only three macropterous individuals were seen. No eggs were found, and none of over 20 females dissected contained many fully formed eggs. Two Dipterous larvae,

presumably *Sarcophaga atlanis*, Aldr., were found in cyanide bottles in which about 60 adults of *D. quercus* had been killed, and a third in a dissected female. On 19th August, oaks in a district about six miles to the north-west were reported to have been severely defoliated, evidently by *D. quercus*. It is not known whether these outbreaks are regularly cyclic or whether they are due to the relative absence of control factors ; parasitism is of some importance [*loc. cit.*]. The injury caused to the more desirable species of oak is serious, even if the area affected is limited, since the trees are often defoliated too severely to recover.

JAMES (H. C.). **The Bionomics and Control of *T. flavilatera* Ur., the Demerara Sugar Cane Froghopper.**—*Proc. Brit. W. Ind. Sug. Technol. 1946* pp. 34–79, 3 graphs, 7 refs. Bridgetown, Barbados, 1946.

Tomaspis flavilatera, Urich, which has been injurious to sugar-cane in British Guiana since 1943, is structurally very similar to *T. saccharina*, Dist., the sugar-cane froghopper of Trinidad, but can be distinguished by its colour pattern. Observations on its bionomics showed that the adults were ready to mate immediately after emergence and the period before oviposition began averaged 8·44 days. Adult females lived for up to 14 days and the males not so long. Although the favourite site for oviposition is the soil, gravid females did not lay eggs in air-dried soil even when no other was available, but dampness varying from just sufficient to make the particles of soil cohere to complete saturation appeared to be equally acceptable. Oviposition was not observed in the field, and in the laboratory it occurred only in heavy shade or darkness. In the field, most of the eggs were laid near the base of the cane stalks, but the presence of plant roots was not necessary in the laboratory. The eggs were inserted singly into small depressions made in the surface of the soil. A female could lay many eggs in a few hours, and oviposition was completed in a few days. The largest number of living nymphs obtained from a single female was 96, and the average in the laboratory was 10·94.

Breeding experiments in which 17,303 nymphs were obtained from eggs laid by adults collected at intervals throughout the second wet season of 1945 showed that hatching began 13 days after oviposition ; 88 per cent. of all eggs hatched in the third week of incubation, but the period necessary for complete hatching of the brood varied from 72 to 157 days. Eggs hatching after 26 or more days of incubation were regarded as long-period eggs, and 816 of the 17,303 eggs that hatched were of this type. Long-period incubation, however, is much less developed in *T. flavilatera* than in *T. saccharina* [*cf. R.A.E.*, A **19** 457] and does not play a decisive part in its economy. Low humidity inhibited hatching, but even when the humidity is adequate other factors sometimes prevent it. Females collected in November and May, at the beginning of the rainy seasons, laid a significantly higher proportion of long-period eggs than those collected later. There were four nymphal instars, which lasted 4–6, 4–6, 10–12 and 8–14 days, respectively ; the nymphal stage lasted 28–36 days for 37 individuals, and the average life-cycle, both as calculated and as indicated by population trends in the field, was approximately 57 days.

Two days in air-dried soil had no apparent effect on the viability or rate of development of the eggs, but 14 days retarded development and caused a very marked mortality, the viable progeny of 210 females being only 1·32 nymphs per female, as compared with 26·75 per female under conditions of adequate moisture. Three experiments showed that the eggs from females collected in January have no special drought-resisting powers despite the imminence of the dry season, the number of viable progeny per female being only 0·11–0·6 after the eggs had been maintained in air-dried soil for 28 days. From these experi-

ments it appears that well over 90 per cent. of the eggs die in dry soil within 28 days, and the failure of the eggs to survive dry conditions in important numbers is probably the most important biological difference between *T. flavilatera* and *T. saccharina*. The survival rate of eggs in soil under water is high ; 6·95 nymphs per female hatched in 68 days after the water was withdrawn from soil that had been submerged for 28 days and 2·79 per female within 35 days from soil that had been under water for 90 days. These experiments indicate that short-period floodings up to about a month might increase infestation by rendering the soil fit for maximum oviposition and would have a preservative rather than a destructive effect on eggs in the soil ; the flooding of heavily infested land would have to be continued for a year to ensure a reduction of viable eggs to unimportant numbers. Effective drainage delays and hinders mass oviposition, particularly in heavy soils ; a good tilth should be maintained to prevent cracking in dry weather, as the latter greatly increases the area of damp surface available for oviposition.

The results are given of a survey of natural enemies [*cf.* **35** 427]. Spores that infected about 8 and 20 per cent. of living adults of *T. flavilatera* in two cage experiments were reared in the laboratory from dead adults of *T. saccharina* infected with green muscardine fungus (*Metarrhizium anisopliae*) imported from Trinidad, but an attempt to establish the fungus on a sugar plantation by distributing about 500 lb. of spores diluted with flour was unsuccessful. Less than a year later, however, adults of *T. flavilatera* on an estate about 20 miles away were found to be fairly heavily infested with the fungus.

Because of the absence of any immediate prospect of improving biological control, drift dusting [*cf.* **29** 52 ; **35** 141] was tested. A dust (Agrocide 3) consisting of benzene hexachloride in a carrier (chiefly china clay) and containing 0·5 per cent. γ isomer was applied from a large duster mounted on a cane punt that was propelled along the waterways by hand, or from a small one if the fields lacked suitable waterways, preferably from about daybreak to 7 a.m. or from 6.30 p.m. onwards, when calm spells can usually be expected. The results of 18 tests, which are given in tables, showed that the mortality percentages varied from 11·63 to 63·01 when the infestation before treatment ranged from 43 to 150 froghoppers per 40 canes and the rate of application was 20 lb. per acre, and from 52·38 to 78·69 when the initial infestation was 55–349 and the rate 40 lb. Mortality tended to be lower for the lower rates of infestation.

It is concluded that it is seldom worth while to dust against infestations of less than ten adult froghoppers per stool, except perhaps early in the growth of the crop to assist in destroying the nucleus of an infestation. It is necessary to time applications carefully, and estates on which loss from froghoppers occurs or threatens to do so should be inspected systematically. Monthly counts of adults should be made over the whole infested area, and daily ones in fields in which infestation appears to be increasing, as well as counts of nymphs in fields in which much nymphal froth is present, as although there is little migration, sudden outbreaks may occur when conditions are exceptionally favourable for oviposition and incubation. Adult counts should be made on 40 canes taken at random, eight from different stools in each quarter of the field and eight from the middle. The most favourable time to dust is when the population rises sharply to a peak within six days (before the maturation period of most females has been completed and oviposition begun). In such circumstances, dosages of 20, 30 and 40 lb. dust per acre should be applied to infestations reaching a maximum of 30, 30–50 and more than 50 per stool, respectively. If the trend is still upwards after the first application, a second should be made six days later at the dosage appropriate to the incidence at that time. If daily

counts show that the population is increasing relatively slowly to highly injurious levels, the appropriate dosage should be applied six days after a definite upward trend becomes evident and again six days later if the trend is still upwards. During droughts, when *T. flavilatera* is particularly vulnerable in both the egg and the nymphal stages, every means should be taken to destroy the nuclei of future outbreaks ; Cyanogas calcium cyanide [*cf.* **31** 53, etc.] can be used against the nymphs if necessary in small areas.

Experiments showed that drift dusting with 0·5 per cent. γ benzene hexachloride, even at a rate of 500 lb. per acre, which is far beyond the dosage likely to be required for froghopper control, caused no increase in the numbers of *Diatraea saccharalis*, F., and *D. canella*, Hmps., on the treated areas.

JAMES (H. C.). **Insect Pests of Sugar Cane.**—*Sug. Est. Overseers Manual Instr. Brit. Guiana* repr. 35 pp., 42 figs. Georgetown, Brit. Guiana [1947].

The greater part of this manual on insects that attack sugar-cane in British Guiana deals with *Diatraea* spp. and *Tomaspis flavilatera*, Urich, but it also contains information on less important pests. These comprise the yellow cane Aphid, here recorded as *Sipha flava*, Forbes [*cf. R.A.E.*, A **24** 260 ; **25** 252 ; **26** 369 ; **28** 94], three species of Dynastids [*cf.* **21** 615 ; **26** 369], the leaf-eating caterpillars, *Laphygma frugiperda*, S. & A., and *Mocis* (*Remigia*) *repanda*, F., *Castnia licoides*, Boisd. (*licus*, auct.), *Metamasius hemipterus*, L., the mealybugs, *Pseudococcus calceolariae*, Mask., and *Trionymus* (*P.*) *sacchari*, Ckll., and termites.

Diatraea canella, Hmps., and *D. saccharalis*, F., are common on sugar-cane, whereas *D. impersonatella*, Wlk., is rare on that crop but common on *Paspalum* spp. The life-history of the borers and the type of damage they cause are described ; suitable cultural practices and field sanitation give some control. The eggs are parasitised by *Trichogramma minutum*, Ril., and *Telenomus* (*Prophanurus*) *alecto*, Crwf., the larvae by *Ipobracon grenadensis*, Ashm., *Stomatodexia* (*Leskiopalpus*) *flavipennis*, Wied., and rarely by *Theresia* (*Paratheresia*) *claripalpis*, Wulp, and the pupae, particularly those of *D. canella* and *D. saccharalis* in *Paspalum*, by a species of *Spilochalcis*, but none of these indigenous parasites gives much control. The introduced parasite, *Metagonistylum minense*, Tns., gives moderate control of *D. saccharalis* [*cf.* **24** 435], but *Lixophaga diatraeae*, Tns., which was introduced from Cuba about ten years ago, failed to establish itself.

Details are given of the bionomics and control of *Tomaspis flavilatera* [*cf.* preceding abstract], and the damage caused to the plants by the feeding of the nymphs on the roots and the adults on the leaves is described. The eggs of the Cercopid can be destroyed by forking over the ground soon after reaping, and investigations are being carried out on the use of insecticides against them. Methods of making egg surveys to determine which areas should be treated have been developed. Counts made at five stools in each of five well distributed situations give a reliable survey for a five-acre field ; for larger fields the number should be increased proportionately. If the tilth is fairly fine and there are no well-marked cracks, an examination of the top inch of soil between the stalks of the stool and for about six inches round it is sufficient, but since females lay eggs in most of the accessible damp surfaces, the interfaces of cracks, the lower surfaces of clods and the damp trash round the base of the stools should be examined to a depth of five inches or more.

One of the commonest termites in cane fields is *Eutermes* (*Nasutitermes*) *costalis*, Hlmgr., which often builds so many large " nigger-head " nests on the cane stalks before they are cut that systematic removal and burning are necessary. If this termite succeeds in entering the stalks through a borer hole

or other break it rapidly eats out the pith. A species of *Eutermes* entirely hollows out the "tops" or "seed-pieces" in newly planted fields and also cleans out the stems of more mature cane when it has the opportunity. If an area becomes badly overrun with termites, they can be controlled by flooding for about 72 hours. *Camponotus* (*Tanaemyrmex*) *picipes*, Ol., is the only natural enemy of any value.

Insect Pests.—*Agric. Gaz. N.S.W.* **58** pt. 12 pp. 634–638, 2 figs. Sydney, 1947. *Op. cit.* **59** pt. 1 pp. 43–46, 3 figs. 1948.

The first of these two parts of a series on insect pests in New South Wales [*cf. R.A.E.*, A **36** 248] includes notes on the use of BHC (benzene hexachloride) in grasshopper baits [*cf.* **35** 216] ; the recommended concentrations for powders containing it are equivalent to 0·3 lb. actual BHC per bag of about 110 lb. bran. The bait should be moistened (with about 2½ gals. water per 24 lb. bran) on the day it is to be used, as it heats if kept long in the bags after moistening. In general, baits of BHC in bran were very effective and were preferred by growers to arsenical baits, the effects of which are less rapid. Mixtures of bran and sawdust were also used on a small scale and were sometimes effective when the proportion of bran to sawdust was only 1 : 3. In preparing the bait, the BHC should be mixed with the bran, which is the attractant, before the sawdust is added ; it requires less water than bran alone, especially if the sawdust is fresh.

It appeared that the BHC in the baits acted to a considerable extent as a contact insecticide, since mixtures in which the carrier consisted entirely of sawdust gave high mortality in experiments, and because the full effect of the bait was sometimes not apparent for at least three days, and the swarms disappeared or dispersed over considerable areas without many dead hoppers being found. For this reason baits should be effective if applied generously to massed swarms at times when the grasshoppers are moulting or are not feeding actively owing to hot, cold or windy conditions. The contact action of BHC was subsequently proved by experiments in which it gave high mortality when applied alone to massed swarms at a rate of approximately 2 oz. γ isomer per acre.

A dust containing 10 per cent. BHC was sprinkled round and introduced into the entrances of a large mound of a species of *Iridomyrmex* (stated in the second part to be *I. detectus*, F. Sm.) ; the mound was then disturbed, so that the ants left it in large numbers, and all those outside it were dead within half an hour.

The second part includes notes on the control of Collembola, which usually feed on decaying matter in the soil but, under certain conditions, attack seeds and sprouting seedlings and the delicate foliage of growing plants. Solutions of nicotine sulphate with soap or of lime-sulphur are used for their control, but DDT dusts applied to the surface of the soil were ineffective, even at high rates. *Onychiurus fimetarius*, L., is one of the commoner species, and in recent tests against it in decaying straw under fruit trees, a suspension of 0·2 per cent. dispersible BHC powder applied at a rate of 9 pints per sq. yard gave good control, and the effect of an application at a rate of 24 pints per sq. yard persisted for at least two weeks. Naphthalene and paradichlorbenzene were effective when mixed with the straw at a rate of 2 oz. per sq. ft., but their action was relatively slow, and a solution containing 0·4 per cent. hexaethyl tetraphosphate at a rate of 1 pint per sq. ft. was completely ineffective. A spray of 0·1 per cent. BHC applied to a cabbage seed-bed in sufficient quantity to wet the soil as well as the plants did not injure the seedlings and protected them for at least one week. Soil containing 0·0125 and 0·025 per cent. γ BHC appeared promising to use for seedlings or as potting soil.

ALLMAN (S. L.). **Thrips injure Nectarines. Excellent Control by D.D.T. Spray.** —*Agric. Gaz. N.S.W.* **59** pt. 1 p. 31. Sydney, 1948.

Unsightly blemishes on nectarines have caused losses up to 100 per cent. in the Sydney area of New South Wales in recent years, and preliminary observations indicated that the injury was caused by colonies of immature thrips feeding beneath the sepals of the young fruits. One application of a spray containing 0·1 per cent. DDT applied when all the petals had fallen gave very good control of the thrips, with a corresponding decrease in the damage.

SMITH (W. A.). **Banana Rust Thrips Control.**—*Qd agric. J.* **65** pt. 5 pp. 315–318. Brisbane, 1947.

In view of promising results obtained in northern Queensland in the control of the banana rust thrips [*Scirtothrips signipennis*, Bagn.] with DDT [*cf. R.A.E.*, A **35** 245] and BHC (benzene hexachloride), experiments were carried out early in 1947 to ascertain whether these insecticides would be effective in southern Queensland. The materials tested comprised, in the first experiment (January–May), dusts of 2 per cent. DDT or 3 per cent. nicotine, or combination dusts containing 2 per cent. DDT and 2 per cent. nicotine, all of which were applied to the bunch and bunch stalk, and, in the second experiment, later in the summer, dusts containing 4 per cent. DDT, 4 per cent. BHC (equivalent to 0·5 per cent. γ isomer), and an agricultural emulsion spray containing 0·2 per cent. DDT, which were applied to the whole stool in an attempt to prevent reinfestation of the bunch. Except for nicotine alone, the treatments in the first experiment were applied at fortnightly intervals ; those in the second were applied when fortnightly examinations showed them to be necessary.

The nicotine dust, applied at weekly intervals throughout the life of the bunch, kept the fruits free from commercial rust, although the top hand in some bunches was moderately damaged. Somewhat better control was obtained when this dust was applied at fortnightly intervals to bunches covered with double brown-paper tubes [*cf.* **29** 436] as early as practicable, and even when dusting was discontinued after three treatments, very few of the covered bunches showed commercially rusted fruits. The 2 per cent. DDT dust kept the fruit free from commercial rust whether it was applied only four times or throughout the life of the bunch, but some rust developed when the number of treatments was reduced to three. The 4 per cent. DDT dust, which was applied when the thrips were less active, also gave almost complete protection, but there was no indication that the higher concentration of DDT was necessary. The emulsion containing DDT also gave good protection but caused some scorching of fruits, which, it is thought, might be avoided by using a water-dispersible DDT powder. Treatment of the bunch alone proved no less effective. One of the combined DDT and nicotine dusts, the components of which were mixed just before each application, gave results comparable with the nicotine dusts applied weekly ; the other dust, which was purchased ready mixed, gave reasonable control but was on the whole inferior to any other treatments. The BHC dust, applied when thrips activity was relatively low, gave complete protection against commercial rust and showed promise of being equal or superior to DDT. When an emulsified solution of BHC was tested in sprays containing 0·025, 0·0375 and 0·05 per cent. active ingredient, the fruits were scorched at all concentrations.

It is recommended that measures against *S. signipennis* should be begun when smokiness (an early indication of thrips activity) becomes fairly general, normally in November or later. Four applications of a 2 per cent. DDT dust on each bunch at fortnightly intervals from the time it is thrown should normally give adequate control, but if rust subsequently develops on some of the

bunches thrown in early summer, treatment should be continued throughout the life of the bunch. The first treatment should be applied to each bunch as early as practicable, and bunches that have emerged from the throat of the plant but have not yet opened should also be lightly dusted. The DDT dust should still be applied if hessian covers are used, but care should be taken to obtain a light, even covering of dust, since the residues are not removed by rain and wind as on uncovered bunches.

Smith (J. H.) & Caldwell (N. E. H.). **Army Worm and other Noctuid Outbreaks during 1946 47.**—*Qd agric. J.* **65** pt. 6 pp. 396–401. Brisbane, 1947.

Following an unusually dry winter and good spring rains in September, outbreaks of the Noctuids, *Cirphis* (*Sideridis*) *unipuncta*, Haw., and *Laphygma* (*Spodoptera*) *exempta*, Wlk., chiefly on graminaceous plants, and of *Agrotis ypsilon*, Hfn., caused considerable damage in Queensland during the summer of 1946–47. Larvae of *C. unipuncta* were observed on several crops during October, but little damage was caused until February, when dense bands of larvae were reported in fodder crops in Warwick, and further reports of bands were received in rapid succession from other parts of the Darling Downs. The larvae were particularly active between February and April, when many of the summer fodder and grain crops that had been planted extensively were approaching the heading stage ; they included Sudan grass [*Sorghum sudanense*], *Panicum*, dwarf *Setaria*, and maize, all of which were attacked, but grain sorghum was apparently avoided. On maize, the attack coincided with that of *Heliothis armigera*, Hb., so that both the flag and flowering parts of the plants were seriously injured. Larvae of *C. unipuncta* showed a distinct preference for the younger and more succulent growth at and near the growing tip particularly when the crop was coming into head. An unusual feature was the even distribution of the larvae, three or four of which were commonly seen feeding on every plant over 50 acres or more. They were parasitised by Ichneumonids and a Braconid of the genus *Apanteles* and preyed upon by the Carabid, *Calosoma maderae*, F. (*australis*, Hope). Baits of 8 oz. arsenic pentoxide, 25 lb. bran, 4 lb. molasses and 2½ gals. water, distributed in and around the infested area, gave good control, and sprays of 0·1 per cent. DDT killed many larvae and caused a sharp decline in damage.

In March, hordes of larvae of *L. exempta* were reported from the Clermont district, and shortly afterwards from the coastal highlands at Maleny ; the outbreak in southern Queensland was particularly severe. Native pastures as well as *Paspalum* were attacked ; in the former, the development of the outbreak was conspicuous, as the grasses were mainly of the stooling type, whereas in *Paspalum* and other established pastures that have a matted sward, the activities of the larvae were unnoticed until brown patches appeared in late summer and autumn ; the roots were not killed unless the attack was very heavy and prolonged. The outbreak lasted about two months and included at least two generations of the insect between late February and early May ; the second generation was the more injurious and damage was severe in late April. The larvae were attacked by numerous parasites, notably the Ichneumonid, *Lissopimpla semipunctata*, Kby., adults of which were seen in flight just above the infested pasture even before it showed signs of injury. Poison baits gave good control, and DDT sprays, applied liberally at a concentration of 0·1 per cent., gave excellent results in gardens and on golf and other greens where the use of arsenicals was undesirable ; one application usually reduced the infestation to negligible proportions.

In the spring, cutworm damage to cultivated crops was very little greater than usual, but in the autumn, outbreaks, mainly of *A. ypsilon*, were recorded

in all the more important fruit- and vegetable-producing areas south of Gympie. An unusual feature was the infestation of strawberry plants, the leaf-stalks of which were either severed at the base or so severely injured that the leaf collapsed. Applications of poison baits along the rows gave effective control, and sprays of 0·1 per cent. DDT, directed downwards to the base of the plants, gave uniformly good results; this method of controlling cutworms seems likely to supersede the more cumbersome baiting technique.

Cannon (R. C.) & Hegarty (A.). **An Outbreak of Grass Webworm in Atherton Tableland Pastures.**—*Qd agric. J.* **65** pt. 6 pp. 402–405, 5 figs. Brisbane, 1947.

Early in 1947, an outbreak of the grass webworm, *Calamotropha leptogramella*, Meyr., occurred on the Atherton Tableland in the Peeramon area of Queensland, and caused considerable destruction in pastures of *Paspalum dilatatum*. This Pyralid has been recorded from various parts of Queensland, and an outbreak occurred in the Lockyer valley in 1935. The eggs are presumably laid on the flag of the grass, and the larvae crawl to the base of the young shoots, where they cut a hole through the sheathing leaves and tunnel into the growing tissues, cutting off many of the younger leaves and eventually destroying the growing tip and flag. They produce a little light webbing as they feed, and pupate in thicker silken cocoons in or near the base of the stool. The affected grass turns brown and has an appearance similar to that due to attack by *Lepidiota caudata*, Blkb., and other white grubs, but the root system is not damaged. Injury in the Peeramon area was first apparent in February (when the larvae were actively feeding), adults were numerous by March, and larvae were still in evidence, though less abundant, in April, and could be found in very small numbers as late as June. It thus appears that two generations were feeding between February and April, when most of the damage was caused. It was estimated that the pest was present in some 5,000 acres of grassland, although probably only half this area suffered severely. The outbreak did not subside until after the cessation of the monsoon rains, and recovery was slow owing to unfavourable weather and the growth of weeds, which had proceeded almost unchecked. In some areas the pastures showed signs of injury by white grubs as well as webworms.

It is thought the *C. leptogramella* is present in the Peeramon area each season, but that it is normally controlled by parasites. Since the months preceding the outbreak in 1947 were exceptionally dry, parasite mortality may have been such as to allow it to develop. A spray containing 0·1 per cent. p,p′ DDT and dusts containing 2 per cent. p,p′ DDT or 0·4 per cent. γ benzene hexachloride gave effective control in a small-scale test.

Barnes (H. F.). **Gall Midges of economic Importance. Vol. III. Gall Midges of Fruit.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., 184 pp., 9 pls., 467 refs. London, Crosby Lockwood & Son, Ltd., 1948. Price 15*s*.

This third volume of a series on Cecidomyiids of economic importance deals with those that attack fruit crops and resembles the previous two [*R.A.E.*, A **34** 251] in scope and arrangement.

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